California Department of Transportation
Structural and Seismic Analysis Section

PreProcessor for Static and Dynamic Analysis of Concrete Bridges

B A G

Instructions for Users

Prepared by
Gene Klein
Li-Hong Sheng

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INTRODUCTION

GENERAL DESCRIPTION

BAG (Bridge Analysis Generator) is a preprocessor program which generates the McAuto STRUDL input coding (1.1) required to perform a response spectrum dynamic analysis and a static analysis on concrete bridge structures. BAG generates the structural model, loading functions and output requests for a dynamic and static analysis using a minimum amount of geometric and structural input data. The assumptions inherent in the generated model are based on extensive bridge design and analysis experience and are further verified by detailed case studies (1.2,1.3). The STRUDL coding generated by BAG does not run in an ICES-STRUDL environment. The generated STRUDL input coding is easily verified, modified, and saved prior to STRUDL processing. The Caltrans (1.4) (CALifornia Department of TRANSportation) support motions, or design response spectra are stored as STRUDL files and are referenced directly from BAG. Special response spectra may also be input.

The seismic analysis and design of structures is still a relatively new field, employing many engineering disciplines which have their own associated assumptions and limitations. It is important that the user recognize this in formulating a particular analysis. By verifying the applicability of the generated models, the user can insure an accurate and economical seismic analysis.

Lateral loadings, dead loads (for single column bents only), and distribution factors for use in the YIELD program are generated for all of the bents in the structural model. Lateral loads include wind, wind on live load, longitudinal force, temperature, and centrifugal force. Default values are provided in BAG for wind, wind on live load, longitudinal force, and temperature. If the default values are used, the forces and moments generated from the BAG model must be modified using a ratio of the actual forces applied to the structure divided by the applied forces. The user may supply the actual forces and moments appropriate for the structure by modifying the STRUDL coding.

STRUCTURAL MODELING

Idealizing a structure in the form of a mathematical model for a static or dynamic analysis requires the input of the correct structural stiffness parameters. In addition, the correct mass distribution to model the vibrational characteristics of the overall system must be included in the dynamic analysis. The BAG model provides the required number of joints, using default input values, to produce a model consistent with the state-of-the-art for a linear dynamic analysis of a typical bridge structure. The more experienced user may elect to specify the number of required joints to provide a better or more practical model for a particular bridge.

The generated structural model is a space frame composed of straight beam elements with six degrees of freedom at each joint. The structural mass is lumped at each of the generated joints to model inertia effects. Only the three translational inertia effects are considered (the rotational inertia effects are combined with the translational inertia effects in order to reduce the computer memory requirement) in the dynamic analysis. BAG generates the intermediate span and column joints required to model these inertia effects. Additional joints at one foot centers are inserted at abutments and intermediate expansion hinges in order to prevent loss of a portion of the mass at the released end of the member. The program provides default values of 3 joints per superstructure span and 2 joints per column. The lumped mass terms are computed from the member tributary areas using a weight density of 150 lbs mass/cu. ft.

SUPERSTRUCTURE

The horizontal alignment of the bridge can be tangent, curved, or a combination of both, with a maximum of two curves. The bridge alignment is considered to correspond to the centroidal axis of the superstructure. Superstructure elevations are specified at the end abutments and intermediate bents. Elevations of generated intermediate superstructure joints are computed by straight line interpolation from the specified elevations. Curved portions of the superstructure are modelled as a series of straight line elements. The generated members within a single span are all prismatic. The user may, however, specify different section properties and modulus of elasticity for each span. A maximum of 48 spans is permitted for any one BAG run.

Forked or 'Y' superstructures or structures with more than two curves may be analyzed by generating two or more separate models and merging the resulting STRUDL coding.

The procedure for multiple models is as follows:

A normal BAG run is executed to describe the mainline of the structure. This run results in joints and members being described starting at Abutment 1. The actual Abutment coordinates may be input or the default value used. An Abutment to Abutment bearing may also be input for this model (or the default used).

A second BAG run is performed for the branch portion of the bridge. This model is generated with different joint and member numbers by specifying a beginning abutment number that is higher than any span number in the previous model. The coordinates for this abutment are also specified along with the bearing of the abutment to abutment chord.

After both STRUDL data files are generated, the files are combined. Duplicate commands are then stripped from the combined file leaving a complete file ready for execution.

More than one additional model may be added using this procedure. A separate BAG run is required for each additional model.

ABUTMENTS

Bridge abutments may be modeled to account for bearings, soil- foundation interaction and connectivity to the superstructure. Of the six possible degrees of freedom or restraint conditions at the abutment, two are set in the generated model and four are included in the abutment input data. The abutment releases beyond the users control are the rotations about the vertical axis and the centerline of bearing at the abutments. These two rotational degrees of freedom are included in the STRUDL model as moment releases. The remaining four degrees of freedom, three translational and the one rotational about the centroidal axis of the superstructure(i.e., torsion), may be specified in the input data. These four degrees of freedom may be specified as either fixed or free and, in addition, the two horizontal translational degrees of freedom may be represented by linear springs to help model the soil-structure interaction effects. The user may elect, for these four degrees of freedom, to use the default force releases which are described under ABUTMENT RELEASES on the GENERAL DATA PANEL - 2.

BENTS

The bents may be composed of single or multiple columns up to a maximum of 9 columns per bent. The individual columns in a multiple-column bent are connected to horizontal cap members framed into the superstructure at the specified elevation for the bent. The bents may be skewed with respect to the superstructure, or normal(or radial) to the defined superstructure alignment. Foundation effects may be inputed by specifying spring coefficients at the column bases. The spring coefficients can also be added in later to the STRUDL commands by the engineer. Individual columns may be modeled as a series of prismatic sections to simulate a variable cross section. Up to 10 column types may be used for any structure, although only one column type is permitted for each bent.

INTERMEDIATE EXPANSION HINGES
One intermediate expansion hinge may be included in each span of the superstructure. The hinge is always considered normal to the superstructure and releases are made as member releases relative to the superstructure. Releases at a hinge are always modeled the same i.e. FORCE X (longitudinal), MOMENT Z (normal bending), and MOMENT Y (transverse bending) released. ALL other forces and moments i.e. FORCE Y (vertical), FORCE Z (transverse), and MOMENT X (torsional) are considered fixed. Two joints spaced at 1.0 foot are used to model the hinge. All releases are made at the end of the 1.0 foot long member. The hinge joint location described in the input is always located toward the closest bent, with the second joint located 1.0 foot away toward the farthest bent. Seismic restrainer cables may be placed in the bridge superstructure to prevent excessive joint openings during an earthquake. The inclusion in of restrainers in a linear elastic analysis is, however, an approximation because they are assumed to work in compression as well as in tension. Restrainers are modeled as a single truss element which connects the closest adjacent joints. The area of the restrainer used in the analysis is adjusted to provide the same stiffness as the input data requested i.e. L/A of the model equals the input L/A. Comparisons with nonlinear analyses indicate that this will give a fairly good approximation of the overall structural response usually on the conservative side. It is required that restrainer forces be designed by the simplified procedure (see Memo 15-10 and Bridge Design Specifications 3.21.6.1).

PHASE-II RETROFIT
BAG will generate additional nodes, members, and commands for the Phase-II retrofit structural model. The STRUDL commands preceded by a '$' sign give the users one method for making the necesary changes in the structural model required in the Phase-II retrofit analysis.

LOADING

CALTRANS earthquake response spectra are used by the program. CALTRANS earthquake response spectra are unreduced elastic curves with 5% damping. The force levels obtained from the CALTRANS curves are elastic forces which have NOT been reduced for risk and ductility. Earthquake ground accelerations are normally assumed to be directed parallel and perpendicular to a straight line between the abutment joints. Up to seven other directions in the horizontal plane may be optionally specified if desired.

Static loads can be supplied by the engineer or the engineer can use the default values. If the default values are used the engineer must prorate the moments and shears according to the actual loads.

REFERENCES

1.1 "ICES STRUDL", by McDonnell Douglas Automation Company, M6340040, April, 1983.

1.2 Imbsen, R. A., Nutt, R. V., and Gates, J. H., "Seismic Design of Highway Bridges-Workshop Manual", Federal Highway Administration, U. S. Department of Transportation, Contract No. DOT-FH-11-9426, February, 1979.

1.3 Imbsen, R. A., Nutt, R. V., and Penzien, J., "Seismic Response of Bridges-Case Studies", Report No. UCB/EERC-78/4, Earthquake Engineering Research Center, University of California, Berkeley, June, 1978.

1.4 Standard Specifications For Highway Bridges - Thirteenth Edition 1983, AASHTO with revisions by CALTRANS, DIVISION of STRUCTURES, Jan, 1985, pgs 29A-29D.

INPUT PANEL INSTRUCTIONS

PANEL DATA EDIT

There are a total of 9 different panels in this program. Only 10 PF keys are defined for the panel operation and 5 out of these 10 keys are defined for direct access to 5 of the 9 panels. Other panels in SPAN and BENT data can only be access by PF7(backward) or PF8(forward) keys.

PF1 - Run data & Earthquake data panel
PF2 - Geometry & Alignment data panel
PF3 - Quit panel without save
PF4 - Span data panel
PF5 - Bent data panel
PF6 - Partial save without check
PF7 - Page backward
PF8 - Page foreward
PF9 - File
PF10 - Column data panel

In addition to the above PF keys, there are other keys defined for easy operation. The following keys do not apply when using general data panel 1 & 2. These keys only work if it is input at the beginning of each line.

A - Add a line
I - Insert a line
R " - Duplicate current line
D - Delete current line

All bearing angles should be entered as 6 digit integers.

GENERAL DATA PANEL - 1

RUN DATA:

Run Data is used to set parameters used in the STRUDL analysis.

```
*******************************************************************************
*                                                                             *
*                                                                             *
*                               BAG          V 4.00 RELEASE SEPT 1, 1989      *
*     RUN DATA                                                                *
*                                                                             *
*      COMMENTS ===> ________________________                                 *
*      NOM NJS NJC JMAX NSPX    SF    PLOT ANALYSIS ROTATION REDUCE I/O CONDEN.*
*      ___  _   _  ___  ___  _____   _       _        _       _        _      *
*                                                                             *
*     NOM : NO. OF MODES     ( DEFAULT = 12 OR 3 * NO OF SPANS )              *
*     NJS : NO. OF EXTRA JOINTS ADDED PER SPAN ( DEFAULT =  3 )               *
*     NJC : NO. OF EXTRA JOINTS ADDED PER COL. ( DEFAULT =  2 )               *
*     JMAX: MAX. NO. OF JOINTS                 ( DEFAULT = 75 )               *
*     NSPX: MAX. NO. OF SPANS                  ( DEFAULT = 48 )               *
*     PLOT: PLOT LENGTH CODE  ( LENGTH = 18 + 6 * PLOT INCHES, 0 FOR NO PLOT) *
*     ANALYSIS: 0 = STATIC & DYNAMIC , 1 = DYNAMIC ONLY , 2 = STATIC ONLY     *
*     ROTATION: 0 = YES              , 1 = NO                                 *
*   ------------------------------------------------------------------------- *
*     EARTHQUAKE LOAD DATA                                                    *
*   PEAK :CURVE:    UP TO 6 ADDITIONAL OPTIONAL DIRECTIONS FOR GIVEN LOAD     *
*   ROCK : DES.:          :          :          :          :          :       *
*   ACC. :     :    2     :    3     :    4     :    5     :    6     :   7   *
*  1/10 G: A-D :          :          :          :          :          :       *
*    _    _ _ _____ _ _ _____ _ _ _____ _ _ _____ _ _ _____ _ _ _____ _       *
*   SPECIAL SITE SPECTRUM ________  (8 CHARACTERS NAME FOR STRUDL)            *
*  F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL *
*                                                                             *
*                                                                             *
*******************************************************************************
```

COMMENTS:

Enter a maximum of 24 alphanumeric characters to identify your problem. The comments are utilized as the ('title') for the STRUDL statement and for all dynamic loads.

NOM (NUMBER OF MODES FOR DYNAMIC ANALYSIS)
Enter the number of modes to be included in the response analysis computation. If this field is left blank, the program defaults to 3 times the number of spans or 12, whichever is greater.

NJS (NUMBER OF JOINTS PER SPAN)
Enter the number of extra joints to be added to each span in order to model the inertia effects.

The program automatically inserts 0 to 6 equally spaced extra joints per span (or long hinge). The user specifies the number of extra joints, using one of the three options described in

Table 1. A zero or blank in this field automatically inserts 3 additional joints per span.

NJS (input)	No. of Joints added per Span
0 or blank	3 (default)
1 - 6	1 - 6
7 - 9	0

Table 1

NJC (NUMBER OF EXTRA JOINTS PER COLUMN)
Enter the number of extra joints to be added to each column in order to model the inertia effects.

The program automatically inserts 0 to 4 equally spaced extra joints per column. The user specifies the number of extra joints, using one of the three options described in Table 2. A zero or blank in this field automatically inserts 2 additional joints per column.

NJC (input)	No. of Joints added per Column
0 or blank	2 (default)
1 - 4	1 - 4
5 - 9	0

Table 2

JMAX (MAXIMUM NUMBER OF JOINTS)
Enter the maximum number of joints describing the structure. The default value used is 75 joints.

This value is used as a safety protection to suppress the execution of the dynamic analysis of large problems. The user may elect to specify any number of joints up to the maximum of 1853 (i.e., 1600 superstructure and 253 substructure joints) permitted by BAG. If the specified or default value is exceeded, BAG will insert a SCAN ON command which will inhibit the dynamic analysis in the subsequent STRUDL run. In addition, BAG will insert STATISTICS ANALYSIS commands to provide the user with an estimate of the computer resources required for the STRUDL dynamic analysis. The user may purposely elect to inhibit the analysis by specifying only 1 joint for JMAX. Experience has shown that when the number of joints exceeds 75, computer resources required for the analysis need some adjustment for a special run. It is always a good practice to inhibit a complete run by specifying a '1' for large problem.

By specifying JMAX less than the number of joints generated, only the dynamic analysis portion of the STRUDL run is suppressed; all generated geometry, releases, plots, etc., will be computed and output. Execution of the run can be accomplished by removing the SCAN ON line from the STRUDL coding. Execution of the special run should be made after consultation with the Structural and Seismic Analysis Section.

NSPX (MAXIMUM NUMBER OF SPANS)
Enter the number of spans describing the structure. The default value is 48 spans.

The default value of 48 spans is specified in the program and cannot be overridden. However the user should give some thought to the special modeling considerations required for a bridge containing 10 or more spans. If there are more than 48 spans in a run, the user should consult with the Structural and Seismic Analysis section (SASA) to obtain a special run.

SF (SPECTRAL MODIFICATION FACTOR)
All values of the elastic response spectra will be multiplied by this factor. If this is left blank, a default value of 1.0 will be assumed.

PLOT (STRUCTURE PLOT)
A '0' or blank indicates that no structure plot is desired. If a plot is desired, the user must enter a number of 1 or more in this field. A three-dimensional plot of the generated structure geometry will be plotted.

The maximum horizontal length of the plot will be 18" plus 6 times the plot input number (for example, if PLOT = 1 the maximum length will be 18" + 6(1) = 24"). The maximum vertical dimension is always 8 inches. Normally a 1(24") will provide a satisfactory plot. Very long and low bridges would require a longer horizontal dimension to adequately show the model. For example, a 1,000 foot long bridge, 20 feet high when scaled to 24" length would only be 0.48" high. By specifying PLOT = 9, the maximum length would be 18 + 6(9) or 72" with a height of 1.44".

BAG generated plot commands will be inserted if any value other than a '0' or blank is entered in the plot field, however, no plot will be generated unless a plot request is specified when executing the STRUDL program.

ANALYSIS
An entry in this field enables the user to determine the type of analysis desired. The default value of '0' or blank creates all of the STRUDL commands to run both a static and dynamic analysis. A '1' in this field generates the STRUDL commands to

run only a dynamic analysis. A '2' in this field generates STRUDL commands to run only a static analysis.

ROTATION
A '0' or blank in this field permits the structure to be rotated in a horizontal plane so that the centerline of the structure or the chord between the abutments coincides with the GLOBAL X axis. A '1' in this field prohibits the rotation of the structure if NO ROTATION ANGLE is given on GENERAL DATA PANEL - 2 and should be used when creating a model composed of several BAG runs. In general the initial BAG run will be rotated. The default value is '0'.

REDUCE I/O
Not used at present.

CONDENSE
Not used at present.

EARTHQUAKE LOAD DATA

PEAK ROCK ACCELERATION
Specify the peak rock acceleration, given in tenths of the acceleration of gravity, ranging from 1 to 7 (i.e., 0.1 to 0.7).

CURVE DESIGNATION
Indicate the response spectrum curve to be used representing the depth to rock like material, as shown in Table 3. Only curve designations A through D will be accepted.

Depth to "Rock-Like Material	Curve Designation CALTRANS
0- 10 ft.	A
11- 80 ft.	B
81-150 ft.	C
More than 150 ft.	D

Table 3 - Response Spectrum Curve Designation

DIRECTIONS RESPONSE SPECTRA LOADINGS
The first loading for Direction 1 will be oriented both parallel and perpendicular to the glocal X and Z axes. Optionally up to six additional load directions may be specified by entering their direction as a bearing. Each additional load generation is a separate unique STRUDL run. This is necessary because each new direction requires rotation of the structure in order to orient the global X axis parallel to the specified direction.

Only one plot and/or reduced SCAN ON run will be generated for multiple load runs.

Each separate STRUDL problem is generated with a FINISH at its end. Only one STRUDL JOB may be executed at a time with a condense, so the user must bypass and execute each loading separately. The load name is the azimuth direction relative to the original geometry of the bridge. **If structure is forced to roate by the input angle or is not allowed to rotate, enter addition response sprectra loading, then result is unpredictable.**

SPECIAL SITE SPECTRUM
Specify the special site response spectrum name if it is available from the STRUDL system. If this name is inputed, the BAG will use this name in the coding generation instead of the peak rock acceleration and curve designation. Current special site spectrum are '140-195', '195-280', '280-640', and '640-720' of the century freeway.

GENERAL DATA PANEL - 2

GEOMETRY DATA

This panel is used to input the horizontal geometry for the superstructure. A maximum of two horizontal curves are allowed.

```
*****************************************************************************************
*                                                                                       *
*                                                                                       *
*                                      BAG                                              *
*       GEOMETRY DATA                                                                   *
*        ORIGIN DATA                              TANGENT OR          ROTATION          *
*                  COORDINATES                    BC TO PI              ANGLE           *
*               Z               X                  BEARING            (DEGREES)         *
*                                                                                       *
*        __________     __________            _ ______ _          __________           *
*        CURVE DATA                                                                     *
*               CURVE      DIR       RADIUS        BC          BEARING                  *
*                NO.       R/L         FT          FT         PI TO EC                  *
*                 1         _       _______     ________     _ ______ _                 *
*                 2         _       _______     ________     _ ______ _                 *
*                                                                                       *
*    -------------------------------------------------------------------------------   *
*       ABUTMENT DATA                                                                   *
*                                                                                       *
*    ABUTMENT  STATION :ELEVATION:   BEARING  :          RELEASE                        *
*                FT   :    FT   :             :         FORCE          : MOMENT         *
*                     :         :             :  LONG     TRANS     V :TORSIONAL        *
*                                                                                       *
*       __    ________  _______   _ ______ _   ______   ______   _      _               *
*                       _______   _ ______ _   ______   ______   _      _               *
*                                                                                       *
*    DESIGN TEMPERATURE RANGE (F) :  ___ DEGREES                                        *
*   (TEMPERATURE COEFFCIENT IS BASED ON CONCRETE.  USER SHOULD CHECK STRUDL CODE.)      *
*   F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL         *
*                                                                                       *
*                                                                                       *
*****************************************************************************************
```

ORIGIN DATA

The origin data may be supplied by the user or default values of 10000.00, 10000.00 will be supplied. If forked or 'Y' structures or structures with more than two curves are to be analyzed the origin data must be supplied by the user for all subsequent runs.

COORDINATES(Ft.)

The 'Z' and 'X' coordinates of the beginning point of the geometry data supplied by the user should be large enough to produce positive values for all coordinates generated from the STRUDL model. If the coordinates are generated by the COGO program, the user should input the coordinate in 'Z' direction with the negative value from COGO's 'Y' or 'N' direction.

BEARING

If the bridge is straight only the tangent bearing (Deg,Min,Sec) is required. If the structure is curved enter the bearing of the BC to PI and the remainder of the curve data required.

ROTATION ANGLE

If a '0' or blank is in the ROTATION field on the previous panel the user may specify the angle the structure is to be rotated through.
If no value is specifyed, BAG will rotate the structure based on the description on ROTATION.' Otherwise, BAG will rotate the structure based on the entered angle (clockwise as positive).

CURVE DATA

A maximum of two curves can be input. Zero radius curves are not permitted. Tangent bearings for single curves resulting in an internal angle (i.e., delta) equal to or greater than 180 degrees is not permitted. Negative stationing is not permitted.

CURVE NUMBER

The curve number is specified on the panel. If only one curve is required omit the input for the second curve.

DIR(DIRECTION OF CURVE)

Specify whether the curve is deflected to the left (L) or right (R) as viewed looking ahead on stationing.

RADIUS

Specify the radius of the centerline of the bridge in feet.

BC(BEGINNING OF CURVE) STATION

Specify the beginning of curve (BC) station in feet.

BEARING

Specify the tangent bearing (Deg,Min,Sec) from the point of intersection (PI) to the end of curve.

ABUTMENT DATA

The abutment data is used to specify the abutment number, location, geometry and support condition at the abutment.

ABUTMENT
The beginning abutment number may be supplied by the engineer or the default value used. The default value is 1. In general the default should be used unless forked or 'Y' bridge structures or structures with more than two curves are to be analyzed.

ABUTMENT STATION
The Abutment station in feet at the centerline of the beginning Abutment is given to the nearest tenth-foot. Stationing must increase from the beginning abutment to the end abutment.

ABUTMENT ELEVATION
Specify the actual elevation at the center of gravity of the superstructure in feet or assume an elevation to establish the datum. Only one reference datum is allowed. Abutments and bents must be referenced to the same datum. Zero elevation is not permitted.

ABUTMENT BEARING
The user may specify the bearing (Deg,Min,Sec) of the abutment centerline or leave this field blank. When this field is left blank the abutment centerline bearing will be assumed to be normal to the superstructure centerline (radial on a curved alignment). The bearings at the abutments and bent centerline may be specified in either direction. Bearing specifications resulting in 90 degree skews are not permitted.

Values greater than 90 degrees, or 59 min., or 59 sec. are not accepted.

ABUTMENT RELEASES
Two of the six support constraints at the abutment are assumed to be released as shown in Figure 1a. The user has control over three of the four remaining support constraints (i.e., transverse and longitudinal forces, and torsional moment about the superstructure center of gravity). The user may specify values for these forces and moments or the user may elect to use the default values by leaving the field entirely blank. Currently, two constraints (i.e., transverse and longitudinal forces) may also be described using spring coefficients in kips/in. as indicated on the input panel and shown in Figure 1b. Fixed conditions are indicated by '1' and released conditions by '0'. Any other input configuration of releases will use all of the input values (i.e., no defaults) except the vertical force will never be released. Shown in Table 4 are the abutment constraint specifications that indicate those conditions that are assumed within the program (i.e., no user control), those assumed by default (i.e., entire field blank, and those which may include

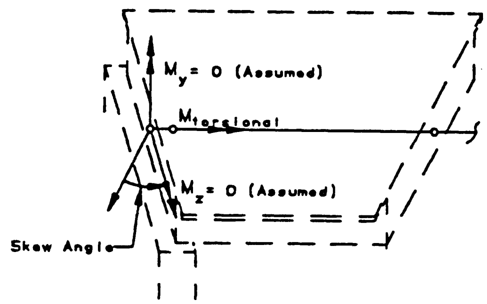
elastic spring coefficients. Abutment force releases or forces for the fixed condition are as shown in Figure 1c.

Constraint	Assumed default	Spring Coefficients
Longitudinal force	Free (0)	Enter value
Transverse Force	Fixed (1)	Enter value
* Vertical Force	Fixed (1)	---
Torsional Moment	Fixed (1)	---
* Transverse Moment	Free (0)	---
* Vertical Moment	Free (0)	---
* No User CONTROL of These Releases		

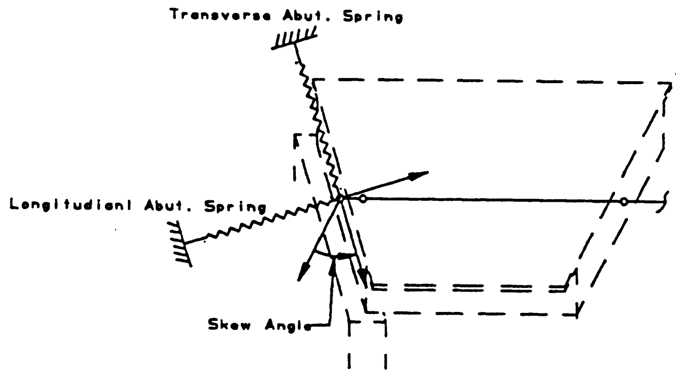
Table 4 - Abutment Constraint Specifications

END ABUTMENT
This portion is used to describe the end abutment. The same data required for beginning Abutment is also required for the End Abutment except end abutment number.

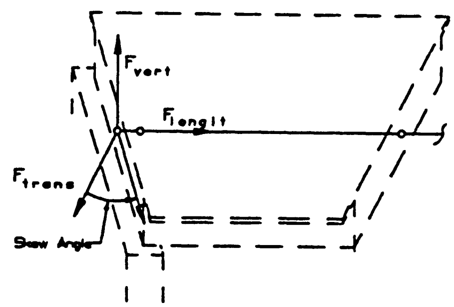
DESIGN TEMPERATURE RANGE
The design temperature range used here is for concrete structures only. For steel structure, user should modify the range by the difference between the two materials (see BDS Article 3.16). The default value is 35 degrees.



a) Assumed Release Conditions



b) Permissable Spring Coefficients & Coordinate Directions



c) Abutment Displacement (or Force) Coordinate Directions

Figure 1
BAG Abutment Release Conditions

SPAN DATA PANEL - 1

SPAN DATA

The geometry and stiffness properties for each span are described on this panel. A total of three panels may be used to describe the input.

```
**********************************************************************************************
*                                                                                            *
*                                                                                            *
*                                                                                            *
*                                            BAG                                             *
*      SPAN DATA - 1                                                                         *
*                                                                                            *
*    SPAN  LENG :MOMENT OF INERTIA  (FT**4):X-AREA      E    STRUCTURE         MASS          *
*     NO.  (FT) :  IZ        IY        IX   :                  DEPTH         ADDITION        *
*               :NORMAL     TRANS     TOR. :(FT**2)   (KSF)    (FT)           (LB/FT)        *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*     __  _____ _______   ________  _______ ______   _______  _____         ________         *
*  F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL               *
*                                                                                            *
*                                                                                            *
**********************************************************************************************
```

SPAN LENGTH
Span lengths (ft.) along the centerline of bridge must be given for each span.

MOMENTS OF INERTIA
Moments of Inertia (ft.**4) of the superstructure must be given for span 1 either from this panel or calculate from the data in SPAN DATA PANEL - 2. The term "normal bending" is used to denote bending caused by vertical loads. For spans 2 through 48 if no value is given, BAG will assume the value from the previous span. Changes in moment of inertia may be designated by providing a new moment of inertia.

CROSS SECTIONAL AREA
The cross sectional area (ft.**4) of the superstructure must be given for span 1 either from this panel or calculate from the data in SPAN DATA PANEL - 2. This area is used to compute the

superstructure weights. For spans 2 through 48 if no value is given, BAG will assume the value from the previous span. Changes in cross sectional area may be designated by providing a new cross sectional area.

SPAN MODULUS OF ELASTICITY
If this field is left blank, a modulus of elasticity of 468,000 ksf for concrete is assumed for the superstructure.

STRUCTURE DEPTH
Enter the superstructure depth of the bridge. The structure depth is used for wind on live load, longitudianl force force, centrifugal force, and column end joint size. If zero structure depth is given, the moments generated by these forces are applied 6 feet above the bridge deck. If a structure depth other than zero is given, the generated moments are applied a distance (6' + 1/2 structure depth) above the C.G. of the structure and column will have a end joint size of 1/2 structure depth at the top. The design engineer may apply the moments created by wind on LL, longitudinal force, and centrifugal force about any axis he perfers by modifying the structure depth accordingly. **If a structure has more than one depth entered, the structure depth used at the column will be the larger depth of the two adjacent spans.**

ADDITIONAL MASS
Enter any masses which might add to the superstructure weight in addition to the cross section of the structure. This includes future wearing surface, barrier rail, and sidewalk. No default value.

SPAN DATA PANEL - 2

SUPERSTRUCTURE SECTION PROPERTIES

If superstructure section properties are entered in SPAN DATA PANEL-1, no additional data is needed for this panel. The superstructure section properties for each span may described on this panel. A total of eight panels may be used to describe the input. In general, this panel is following FRAME SYSTEM input card type B's format.

```
*************************************************************************************
*                                                                                   *
*                                                                                   *
*                                    BAG                                            *
*    SPAN DATA -2                                                                   *
*                   : SUPERSTRUCTURE:  SLAB DATA    :  INT. GIRD.                   *
*              SPAN :     DATA      :  TOP     BOT  :         WEB                   *
*               NO. :     WIDTH     : THICK  THICK  :        THICK.                 *
*                   :     (FT)      :  (IN)   (IN)  :  NUM    (IN)                  *
*               __       _____       _____   _____     __     __                    *
*               __       _____       _____   _____     __     __                    *
*               __       _____       _____   _____     __     __                    *
*               __       _____       _____   _____     __     __                    *
*               __       _____       _____   _____     __     __                    *
*               __       _____       _____   _____     __     __                    *
*                                                                                   *
*         :         EXTERIOR GIRDERS         :              OVERHANGS               *
*    SPAN:        LEFT      :      RIGHT      :      LEFT        :    RIGHT          *
*     NO.:     W.TH. FACT. :     W.TH. FACT. : LEN. E.TH. I.TH.: LEN. E.TH. I.TH.   *
*         :TYPE  (IN) (FT)  :TYPE  (IN)  (FT) : (FT) (IN)  (IN) : (FT) (IN)  (IN)    *
*    __    _     __  ____     _    __   ____   ____  __    __    ____  __    __      *
*    __    _     __  ____     _    __   ____   ____  __    __    ____  __    __      *
*    __    _     __  ____     _    __   ____   ____  __    __    ____  __    __      *
*    __    _     __  ____     _    __   ____   ____  __    __    ____  __    __      *
*    __    _     __  ____     _    __   ____   ____  __    __    ____  __    __      *
*    __    _     __  ____     _    __   ____   ____  __    __    ____  __    __      *
*  F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL      *
*                                                                                   *
*                                                                                   *
*************************************************************************************
```

SUPERSTRUCTURE WIDTH

Enter superstructure width from edge to edge. If superstructure width and structure depth on SPAN DATA PANEL - 1 are missing, no superstructure section property will calculated.

SLAB DATA

TOP SLAB THICKNESS

Enter slab thickness of top slab.

BOTTOM SLAB THICKNESS

Enter slab thickness of bottom slab. Enter 0 in this field if it is T girder.

INTERIOR GIRDER

NUMBER OF INTERIOR GIRDER

Enter number of interior girder. Enter 0 for single cell box girder.

WEB WIDTH OF INTERIOR GIRDER

Enter web width for interior girder only.

EXTERIOR GIRDER

TYPE

Enter exterior girder type, 0 for vertical girder, 1 for sloped girder, 2 for sloped girder with 45 degrees outside slope, 3 for rounded girder. See FRAME SYSYEM manual for detail.

WIDTH

Enter exterior girder web width.

FACTOR

Enter horizontal distance from end of overhang to beginnig of bottom slab.

OVERHANG

LENGTH

Enter horizontal distance from edge of deck to end of overhang.

EXTERIOR THICKNESS

Enter overhang thickness at edge of deck.

INTERIOR THICKNESS

Enter overhang thickness at end of overhang.

SPAN DATA PANEL - 3

SPAN DATA (Continue)

The geometry and stiffness properties for hinge and restrainer, wind load, wind on live load, and live load longitudinal force are described on this panel. A total of three panels may be used to describe the input.

```
************************************************************************************
*                                                                                  *
*                                                                                  *
*                                                                                  *
*                                     BAG                                          *
*      SPAN DATA - 3                                                               *
*                                                                                  *
*   SPAN :----------- HINGE ---------:------ RESTRAINER-----:  WIND   WIND   LL    *
*   NO.  :LOCATION  X-SECTION LENGTH : LENGTH  AREA     E    :  LOAD   ON LL  LF    *
*        :  (FT)     (FT**2)   (FT)  :  (FT)  (IN**2) (KSF)  : (KLF)  (KLF) (KLF)  *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*   __   ______    _____     _____    _____  _____  _______  _____  _____  _____   *
*  F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL     *
*                                                                                  *
*                                                                                  *
************************************************************************************
```

HINGE

HINGE LOCATION

The presence of a hinge is indicated by the distance (ft.) measured from the left end of the span. The hinge must be within the span and cannot be located at the left end of the span since a zero entry would be interpreted as no hinge. Only one hinge per span is possible and no hinges are permitted within the abutment half of the end spans.

HINGE CROSS SECTION

The user must specify the total cross section area of the hinge diaphram in square feet.

HINGE LENGTH
The hinge length in feet is measured along the centerline of the hinge in transverse direction of the bridge along the hinge diaphragm.

***** The corss sectional area and the hinge length are used to calculate the mass of the hinge in lbms/cu. ft.. BAG will evenly distribute the mass of the hinge to the two adjacent hinge joints.

RESTRAINER

RESTRAINER LENGTH
The user may specify the restrainer length in feet. If the length is left blank, a length of 20 feet is assumed for the default value.

AREA
The user must specify the cross-sectional area of the restrainers in square inches. If the area is left blank or a zero restrainer area is input, no restrainer will be generated through that hinge.

RESTRAINER MODULUS OF ELASTICITY
A default value of 1,440,000 ksf (i.e., 10,000,000 psi for a steel cable) is assumed unless a value has been input, in which case it will override the default value.

NOTE: The restrainer generated is a STRUDL space truss member. The restrainer member spans the length of three superstructure members (i.e., the one foot long hinge member and two adjacent superstructure members). Therefore, the area of the restrainer is adjusted within the program so that the restrainer's elastic stiffness will be consistent with the specified length of the restrainer. This is done as follows:

AREA for analysis = Area input X Length for analysis divided by the input length.

WIND LOAD
The user may specify the wind intensity on the bridge (kips/feet). The default value is 1.0.

WIND ON LIVE LOAD
The user may specify the wind intensity on live load (kips/feet). The default value is 0.1.

LIVE LOAD LOGITUDINAL FORCE

The user may specify the logitudinal force caused by live load (kips/feet). The default value is 1.0.

BENT DATA PANEL - 1

BENT DATA

The bent geometry and cap properties are described on this panel. The modulus of elasticity of the bent cap and the columns making up the bent are also described on this panel. The column properties are described on the column data panel.

```
*********************************************************************************
*                                                                               *
*                                                                               *
*                                                                               *
*                                   BAG                                         *
*      BENT DATA - 1                                                            *
*                                                                               *
*   BENT:   ELEVATION   :          :NO.  C-C      E    : COL. : ------ CAP -------  *
*      : TOP    BOTTOM :  BEARING :OF    COL           :      :   IZ    AREA   LENG  *
*    NO.: (FT)   (FT)  :          :COL.  (FT)   (KSF)  : TYPE :(FT**4) (FT**2) (FT)  *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*    __ ______ ______ - ______ - __ ___ ______   _   ______ _____ _____          *
*   F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL  *
*                                                                               *
*                                                                               *
*********************************************************************************
```

BENT ELEVATIONS
Specify the elevation in feet at both the center of gravity of the superstructure and the bottom of column. Both values must be entered. A zero length column (i.e., difference in elevations = zero) is not permitted. The elastic column length is computed as the difference between these elevations. These elevations must be consistent with the abutment elevations.

BENT BEARING
Enter the bearing (Deg,Min,Sec) of the centerline of bent. The bearing may be specified in either direction. When no bent bearing is given it will be assumed to be normal to the superstructure centerline (radial on curved alignment). Bearings resulting in 90 degree skews (i.e., bents parallel to the superstructure) are not permitted.

NUMBER OF COLUMNS IN BENT

The user must specify the number of columns in the bent. A maximum of 99 columns per bent is permitted.

COLUMN SPACING

This entry is required only for bents having more than one column. Specify the distance in feet between the column centerlines along the centerline of the bent. Specifying a column spacing for a single column bent will cause the problem to be rejected.

COLUMN MODULUS OF ELASTICITY

Enter the modulus of elasticity (ksf) of the concrete column. If this field is left blank, a default modulus of 468,000 ksf is used.

COLUMN TYPE

Specify the column type numbers to be recalled for use in the bent. (See Column Data Panel) Note that only one column type may be used in each bent.

BENT CAP DATA

IZ

Enter the moment of inertia (ft**4) for normal bending (i.e., in the plane of the bent caused by vertical loads) and the cross sectional area (ft**2). Note that the moments of inertia about the X and Y axes are assumed by the program. The moment of inertia about the X-axis (i.e., torsion) and the moment of inertia about the Y-axis (i.e., bending in a plane parallel to the superstructure deck) are assumed to be 1000 times IZ. Stiffness about these two axes is usually considerably larger due to the presence of the superstructure surrounding it. This effect is approximated by increasing the two moments of inertia by the factor given above.

AREA

Enter the cap cross sectional area.

LENGTH

Enter the cap length in transverse direction of the bridge along the cap.

BENT DATA PANEL - 2

BENT DATA (Continue)

Loads acting on the bent are described on this panel.

```
*****************************************************************************************
*                                                                                       *
*                                                                                       *
*                                                                                       *
*                                        BAG                                            *
*        BENT DATA - 2                                                                  *
*                                                                                       *
*          BENT: WIND ON COLUMN  :              CENTRIFUGAL FORCE                       *
*              :   LONG    TRANS  :------- H LOAD ------:----- P LOAD -------           *
*           NO.:  (KLF)    (KLF)  :  TRANS   LONG    N    TRANS   LONG    N             *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*           __   ______  ______     _____   _____  _____  _____  _____  _____           *
*                                                                                       *
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL        *
*                                                                                       *
*                                                                                       *
*****************************************************************************************
```

WIND ON COLUMN
The user may enter the column wind forces or use the default values in the BAG program. The default value is 1.0 for the transverse direction and 0.1 for the longitudial direction.

CENTRIFUGAL FORCE
The user must enter the value of the centrifugal force since the BAG program does not provide a default value for this force. The BAG program calculates the moments associated with the centrifugal force using the structure depth previously described. If all six values are omitted, BAG will not generate these loading cases. Enter centrifugal forces by the different loading condition, i.e. the force associate with different live load conditions, max. logintudinal moment, max. tranverse moment, and max. axial force at the bent.

BENT DATA PANEL - 3

BENT DATA (Continue)

The bent support conditions are described on this panel.

```
********************************************************************************
*                                                                              *
*                                                                              *
*                                                                              *
*                                    BAG                                       *
*      BENT DATA - 3                                                           *
*                                                                              *
*    BENT :--TOP OF COLUMN--:--------- FOUNDATION SPRING ON LOCAL AXES ------------  *
*     NO. : MOMENT RELEASE  :        TRANSLATION        :          ROTATION     *
*         :   X    Y    Z   :Z (TRANS)    X    Y (LONG): Z (LONG) X (TOR)  Y (TRANS) *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*     __      _    _    _    _______ _______ _______   _______ _______ _______  *
*   F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL *
*                                                                              *
*                                                                              *
********************************************************************************
```

COLUMN RELEASES AT TOP

MOMENT RELEASES

The user has control over all of the moment releases in the column. The releases are applied in the plane of the bent and apply to all of the columns in the bent. Indicate the column fixity by specifying a zero (or blank) for a moment release and a "1" for continuity (i.e., fixed condition). If the field is left entirely blank (i.e., all three are zeros), fixed conditions will be assumed for moment at the column ends. Note that a single non-zero entry overrides the default and requires a complete specification of all of the releases. If a moment release for torsion is specified at both top and bottom, a program override is invoked, fixing the top in order to avoid an unstable condition.

COLUMN RELEASES AT BOTTOM

FORCE RELEASES

The user has control over all of the force releases at the bottom of column. The releases are applied in the plane of the bent and apply to all of the columns in the bent. Indicate the column fixity by specifying a zero (or blank) for a force release and a "1" for continuity (i.e., fixed condition). If the field is left entirely blank (i.e., all three are zeros), fixed conditions will be assumed for force at the column ends except at the axial direction which is not allowed to release. Note that a single non-zero entry overrides the default and requires a complete specification of all of the releases. In addition to condition specified above, user can input spring constant at bottom of column.

MOMENT RELEASES

The user has control over all of the moment releases at the bottom of column. The releases are applied in the plane of the bent and apply to all of the columns in the bent. Indicate the column fixity by specifying a zero (or blank) for a moment release and a "1" for continuity (i.e., fixed condition). Note that a single non-zero entry overrides the default and requires a complete specification of all of the releases. In addition to condition specified above, user can input spring constant at bottom of column.

COLUMN DATA PANEL

Column Data

This panel is used to describe the column properties. Each column is described by one or more segments extending along the length of the column. Non-prismatic columns are modeled by a series of prismatic segments. One line is required for each column type or segment to be used. A total of six panels may be used to describe the input.

```
*****************************************************************************************
*                                                                                       *
*                                                                                       *
*                                                                                       *
*                                       BAG                                             *
*      COLUMN DATA                                                                      *
*                                                                                       *
*       STORE :                       SEGMENT                                           *
*       COLUMN:       LENGTH  AREA   :   MOMENT OF INERTIA (FT**4)                       *
*        TYPE : NO.    (FT)  (FT**2) :IZ(LONGIT)  IY(TRANS)  IX(TOR)                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*          _    __    _____  ______    _______     _______   _______                     *
*                                                                                       *
*   F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL          *
*                                                                                       *
*                                                                                       *
*****************************************************************************************
```

STORE COLUMN TYPE
Specify the store column type number. A maximum of 10 types (0-9) are permitted for a bridge. The store column types are numbered 0 through 9 and must be identical for all segments of each column.

SEGMENT NUMBER
Segment numbers must be numbered sequentially starting with number 1 at the bottom of the column. A maximum of 20 column segments may be used to describe a column.

SEGMENT LENGTH (ft)
The segment length is not required for a single segment column. Only one zero length segment (i.e., blank) is permitted for a

non-prismatic column. The zero length segment will be used to adjust the overall column length to conform to the elevations specified on the Bent Data Card. If no zero length segment is specified or total of segments length is less than the column length, the first segment at the bottom of the column will be adjusted. The length of all other segments must be specified.

SEGMENT AREA
Specify the cross-sectional area (ft**2) of each prismatic segment for each column type.

SEGMENT MOMENT OF INERTIA
Specify the moments of inertia (ft**4) of each prismatic segment for each column type. These are referenced relative to the plane of the bent.

Note: The "STORE COLUMN TYPE" number must correspond to the "COLUMN TYPE" number specified for recall on the BENT DATA PANEL. These numbers can vary from 0 to 9 and only one column type is permitted in any one bent. All described column types do not have to be recalled by the bent data.

GENERATED OUTPUT

GENERATION NUMBERING CONVENTION

BAG generates joints and members according to a predetermined numbering convention. This makes it easy for the user to interpret the STRUDL output.

JOINTS

Joint numbers are either four or five digits long. Joint numbers are determined by the location of the joints within the bridge model. Table 3.1 defines the significance of the joint numbers.

Joint	Digit Number			
Location	1	2 & 3	4	5
SUPERSTRUCTURE	1	SPAN NO.	JOINT NO.	--
HINGE	2	SPAN NO.	JOINT NO.	--
ABUTMENT	3	SUPPORT NO.	JOINT NO.	--
COLUMN	4	BENT NO.	COL. NO.	JOINT NO.

Table 3.1 - Joint Numbering Convention

MEMBERS

Members are numbered using a similar convention. Table 3.2 defines the member numbering convention.

Joint	Digit Number			
Location	1	2 & 3	4	5
SUPERSTRUCTURE	5	SPAN NO.	MEM. NO.	--
CAP	6	BENT NO.	MEM. NO.	--
COLUMN	7	BENT NO.	COL. NO.	MEM. NO.
RESTRAINER	8	SPAN NO.	--	--

Table 3.2 - Member Numbering Convention

GENERATED STRUDL OUTPUT REQUESTS

The following results are output from the generated STRUDL analysis.

1. FREQUENCIES OF ALL MODES OF VIBRATION

2. Normalized eigenvectors (mode shapes) for the number of modes included in the response spectrum analysis.

3. Dynamic participation factors for the number of modes requested.

4. The square root of the sum of the squares (RMS) of the response spectrum forces and moments at the base and top of all columns for Case 1 and Case 2.

5. The response spectrum RMS forces in the restrainers for Case 1 and Case 2.

6. The response spectrum RMS displacements of the deck joints located at the abutments, bents, and hinges for Case 1 and Case 2.

8. The modal shock sprectrum result force and displacement at location of the above items 4-7 for load case in X and Z directions.

7. The response spectrum RMS forces and moments in the deck at abutments and hinges for Case 1 and Case 2.

INPUT DATA FORMAT (XEDIT)

RUN DATA

(I2,7X,6A4,I3,2I1,I3,I2,F5.4,5I1,1X,2F9.2,I2,I1)

Columns	Entry	Variable
1 - 2	CARD TYPE - 1	IN(1)
3 - 9	BLANK	
10 - 33	COMMENTS	NCOM
34 - 36	NO. OF MODES	NOM
37	NO. OF EXTRA JOINTS PER SPAN	NJS
38	NO. OF EXTRA JOINTS PER COLUMN	NJC
39 - 41	MAXIMUM NO. OF JOINTS	JMAX
42 - 43	MAXIMUM NO. OF SPANS	NSPX
44 - 48	SPECTRUM MODIFICATION FACTOR	SF
49	PLOT CONTROL	NPLT
50	CONDENSE CONTROL	NCND
51	REDUCED INPUT _ OUTPUT DATA	NRIOD
52	DYNAMIC AND STATIC OUTPUT	NRSAD
53	ROTATION CONTROL	NTEST
55 - 63	NORTH COORDINATE	XNC
64 - 72	EAST COORDINATE	XECO
73 - 74	BEGINNING ABUTMENT NUMBER	NA1
75	PROGRAM TYPE	NTYPE

GEOMETRY DATA

(I2,7X,I1,A1,3I2,A1,2(A1,F7.2,F8.2,A1,3I2,A1),F8.2)

Columns	Entry	Variable
1 - 2	CARD TYPE - 2	IN(2)
3 - 9	BLANK	
10	NO. OF CURVES	NC
11	N/S	IQA(1)
12 - 13	DEGREES	XDG(1)
14 - 15	MINUTES	XM(1)
16 - 17	SECONDS	XS(1)
18	E/W	IQB(1)
19	DIRECTION OF CURVE	ND(1)
20 - 26	RADIUS OF CURVE 1 (ft.)	RAD(1)
27 - 34	BEGINNING OF CURVE STA (ft.)	BC(1)
35	N/S	IQA(2)
36 - 37	DEGREES	XDG(2)
38 - 39	MINUTES	XM(2)
40 - 41	SECONDS	XS(2)
42	E/W	IQB(2)
43	DIRECTION OF CURVE	ND(2)

44 - 50	RADIUS OF CURVE 2 (ft.)	RAD(2)
51 - 58	BEGINNING OF CURVE STA	BC(2)
59	N/S	IQA(3)
60 - 61	DEGREES	XDG(3)
62 - 63	MINUTES	XM(3)
64 - 65	SECONDS	XS(3)
66	E/W	IQB(3)
67 - 74	ROTATION ANGLE (degrees)	ROTA

ABUTMENT DATA

(I2,7X,F7.2,(F8.2,A1,3I2,A1,2F6,2I1))

Columns	Entry	Variable
1 - 2	CARD TYPE - 3	IN(3)
3 - 9	BLANK	
10 - 16	BEGINNING ABUT. STATION (ft.)	A1S
17 - 21	BEGINNING ABUT. ELEVATION (ft.)	BT(1)
22	N/S	N(1)
23 - 24	DEGREES	D(1)
25 - 26	MINUTES	XM(1)
27 - 28	SECONDS	S(1)
29	E/W	M(1)
	BEGINNING ABUTMENT RELEASE ARRAY	
30 - 35	LONGITUDINAL	IAR(1,1)
36 - 41	TRANSVERSE	IAR(2,1)
42	VERTICAL	IAR(3,1)
43	TORSIONAL MOMENT	IAR(6,1)
44 - 48	END ABUTMENT ELEVATION (ft.)	BT(IN$+1)
49	N/S	N(2)
50 - 51	DEGREES	D(2)
52 - 53	MINUTES	XM(2)
54 - 55	SECONDS	S(2)
56	E/W	M(2)
	END ABUT. RELEASE ARRAY	
57 - 62	LONGITUDINAL	IAR(1,2)
63 - 68	TRANSVERSE	IAR(2,2)
69	VERTICAL	IAR(3,2)
70	TORSIONAL MOMENT	IAR(6,2)

SPAN DATA - 1

(I2,7X,I2,F4.1,F6.1,F7.1,F6.1,3F5.1,F2,F6.1,F4,2F4.1,F4.2)

Columns	Entry	Variable
1 - 2	CARD TYPE - 4	IN(4)
3 - 9	BLANK	
10 - 11	SPAN NUMBER	N

12 - 15	SPAN LENGTH (ft.)	SP(N)
16 - 21	NORMAL BENDING IZ (ft.**4)	SIZ(N)
22 - 28	TRANSVERSE BENDING IY (ft.**4)	SIY(N)
29 - 34	TORSIONAL IX (ft.**4)	SIX(N)
35 - 39	CROSS_SECTIONAL AREA AX (ft.**2)	SAX(N)
40 - 44	SPAN MODULUS OF ELASTICITY (10**3 ksf)	SMOD(N)
45 - 49	HINGE LOCATION (FROM LEFT END OF SPAN, ft.)	XH(N)
50 - 51	RESTRAINER LENGTH (ft.)	RL(N)
52 - 57	RESTRAINER AREA (in.**2)	AR(N)
58 - 61	RESTRAINER MODULUS OF ELASTICITY (10**3 ksf)	RMOD(N)
62 - 65	HINGE CROSS_SECTION AREA AX (ft.**2)	AH(N)
66 - 69	HINGE LENGTH (ft.)	HL(N)
70 - 73	STRUCTURE DEPTH (ft.)	XD(N)

SPAN DATA - 2

(I2,7X,I2,2F3.1,F4.1,2F4.2,I2,F2,2(I1,F2,F3.2),2(F2.1,2F2))

Columns	Entry	Variable
1 - 2	CARD TYPE - 5	IN(5)
3 - 9	BLANK	
10 - 11	SPAN NUMBER	N
12 - 17	BLANK	
18 - 21	Superstructure width	W
22 - 25	Top slab thickness	TSUBT
26 - 29	Bottom salb thickness	TSUBB
30 - 31	Number of interior girders	NOGIR
32 - 33	Interiro girder width	TSUBW
34 - 34	Left exterior girder type	ITYPE
35 - 36	Left exterior girder width	XLWUBW
37 - 39	Left exterior girder slope factor	XGF(1)
40 - 40	Right exterior girder type	JTYPE
41 - 42	Right exterior girder width	XRWUBW
43 - 45	Right exterior girder slope factor	XGF(2)
46 - 47	Left overhang length	OHL
48 - 49	Exterior thickness of left overhang	TEXTL
50 - 51	Interior thickness of left overhang	TINTL
52 - 53	Right overhang length	OHL
54 - 55	Exterior thickness of right overhang	TEXTL
56 - 57	Interior thickness of right overhang	TINTL

BENT DATA - 1

(I2,7X,I2,2F5.1,A1,3F2,A1,I2,F5.2,F5,I2,F5.1,F4.1,F6.2)

Columns	Entry	Variable
1 - 2	CARD TYPE - 6	IN(6)

3 - 9	BLANK	
10 - 11	BENT NUMBER	N
12 - 16	ELEVATION TOP OF BENT (ft.)	BT(N)
17 - 21	ELEVATION FOOTING (ft.)	BF(N)
22	N/S	ND(1)
23 - 24	DEGREES	DEG
25 - 26	MINUTES	XM
27 - 28	SECONDS	SEC
29	E/W	ND(2)
30 - 31	NUMBER OF COLUMNS IN BENT	NCOL(N)
32 - 36	C-C COLUMN SPACING (ft.)	CC(N)
37 - 41	COLUMN MODULUS OF ELASTICITY (10**3 ksf)	CMOD(N)
42 - 43	RECALL COL TYPE	NCT(N)
44 - 48	MOMENT OF INERTIA (IZ) OF BENT CAP (ft.**4)	CI(N)
49 - 52	CROSS SECTIONAL AREA OF BENT CAP (ft.**2)	CA(N)
53 - 58	BENT CAP LENGTH (ft.)	CAPL(N)

BENT DATA - 2

(I2,7X,I2,3I1,6I8)

Columns	Entry	Variable
1 - 2	CARD TYPE - 7	IN(7)
3 - 9	BLANK	
	COLUMN MOMENT RELEASES TOP	
10	LONGITUDINAL	MRT(1,N)
11	TRANSVERSE	MRT(2,N)
12	TORSIONAL	MRT(3,N)
	COLUMN RELEASES BOTTOM	
	FORCE RELEASES	
13 - 20	LONGITUDINAL	IRB(1,N)
21 - 27	TRANSVERSE	IRB(2,N)
28 - 35	AXIAL	IRB(3,N)
	MOMENT RELEASES	
36 - 43	LONGITUDINAL	IRB(4,N)
44 - 51	TRANSVERSE	IRB(5,N)
52 - 59	TORSIONAL	IRB(6,N)

COLUMN DATA

(I2,7X,I2,I1,I2,F6,F5,3F6)

Columns	Entry	Variable
1	CARD TYPE - 8	IN(8)
2 - 9	BLANK	
10	STORE COLUMN TYPE	J
11 - 12	SEGMENT NUMBER FROM BOTTOM	M

13 - 16	SEGMENT LENGTH (ft.)	SL(J+1,M)
17 - 21	SEGMENT AREA (ft.**2)	SA(J+1,M)
	SEGMENT MOMENT OF INERTIA (ft.**4)	
22 - 27	LONGITUDINAL (IZ)	SIL(J+1,M)
28 - 33	TRANSVERSE (IY)	SIT(J+1,M)
34 - 39	TORSIONAL (IX)	SIX(J+1,M)

EARTHQUAKE DATA

(I2,7X,2A1,6(A1,3F2,A1))

Columns	Entry	Variable
1 - 2	CARD TYPE - 9	IN(9)
3 - 9	BLANK	
10	PEAK ROCK ACCELERATION	PEAK
11	CURVE DESIGNATION	NCUR
	ADDITIONAL DIRECTIONS (MAX. SIX)	
12	N/S	N(I)
13 - 14	DEGREES	D(I)
15 - 16	MINUTES	XM(I)
17 - 18	SECONDS	S(I)
19	E/W	M(I)
62 - 69	SPECIAL SITE SPECTRUM	SPEC

SPAN DATA - 3

(I2,7X,I2,4F4)

Columns	Entry	Variable
1 - 2	CARD TYPE - 10	IN(10)
3 - 9	BLANK	
10 - 11	SPAN NUMBER	N
12 - 15	WIND LOAD (klf)	SWN(N)
16 - 19	WIND ON LIVE LOAD (klf)	SWL(N)
20 - 23	ADDITIONAL MASS (lbm)	MASS(n)
24 - 28	TEMPERATURE RANGE (degrees)	TEMP

BENT DATA - 3

(I2,7X,I2,8F6)

Columns	Entry	Variable
1 - 2	CARD TYPE - 11	IN(11)

3 - 9	BLANK	
10 - 11	BENT NUMBER	N
12 - 17	WIND LOAD ON COLUMN (klf)	SWCT(N)
18 - 23	WIND LOAD ON COLUMN (klf)	SWCL(N)
24 - 29	CENTRIFUGAL FORCE H LOAD CASE 1 (kips)	CFH1(N)
30 - 35	CENTRIFUGAL FORCE H LOAD CASE 2 (kips)	CFH2(N)
36 - 41	CENTRIFUGAL FORCE H LOAD CASE 3 (kips)	CFH3(N)
42 - 47	CENTRIFUGAL FORCE P LOAD CASE 1 (kips)	CFP1(N)
48 - 53	CENTRIFUGAL FORCE P LOAD CASE 2 (kips)	CFP2(N)
54 - 59	CENTRIFUGAL FORCE P LOAD CASE 3 (kips)	CFP3(N)

EXAMPLE PROBLEM

EXAMPLE 1

PROBLEM STATEMENT

Generate BAG input coding to analyze the three span structure shown in Figure 2 using the given properties.

Superstructure Properties

Span length	- span 1	80 ft
	span 2	100 ft
	span 3	80 ft
Total length		260 ft
Cross-sectional area		61 ft^2
Moments of inertia		
Torsion (IX)		809 ft^4
Normal Bending (IZ)		510 ft^4
Transverse Bending (IY)		6200 ft^4
Modulus of Elasticity		468000 ksf

Substructure Properties

Bent 2

Top Elevation	207.0 ft
Bottom Elevation	183.0 ft
Number of columns	1

Column

Cross-sectional area	15.0 ft^2
Moments of inertia	
Torsion (IX)	45.0 ft^4
Normal Bending (IZ)	11.2 ft^4

Transverse Bending (IY)	31.2 ft^4
Modulus of Elasticity	468000.0 ksf

Bent 3

Top Elevation	203.2 ft
Bottom Elevation	148.5 ft
Number of columns	2
Column Spacing	32.0 ft

Column

Cross-sectional area	12.0 ft^2
Moments of inertia	
Torsion (IX)	36.0 ft^4
Normal Bending (IZ)	9.0 ft^4
Transverse Bending (IY)	16.0 ft^4
Modulus of Elasticity	468000.0 ksf

Cap

Cross-sectional area	40.0 ft^2
Normal Bending (IZ)	700.0 ft^4
Modulus of Elasticity	468000.0 ksf

Hinge

Location	20.0 ft from bent 2
Length	24.0 ft
Cross-sectional area	40.0 ft^2

Hinge Restrainer Properties

Length	20.0 ft
Cross-sectional area	3.1 in^2
Modulus of Elasticity	1440000.0 ksf

Seismic Loading (CALTRANS)

Peak rock acceleration	0.6 g
Depth to "rock-like" material	0-10 ft

Horizontal Alignment

Curve 1

Tangent Bearings	
BC to PI	N83 29'40"E
PI to EC	S61 40'25"E
Radius	300 ft
Station BC	10+25.10
Station Abutment 1	11+05.10
Elevation Abutment 1	210.20

Curve 2

Tangent Bearings	
BC to PI	S61 40'25"E
PI to EC	N79 29'30"E
Radius	300 ft
Station BC	12+75310
Elevation Abutment 4	200.20

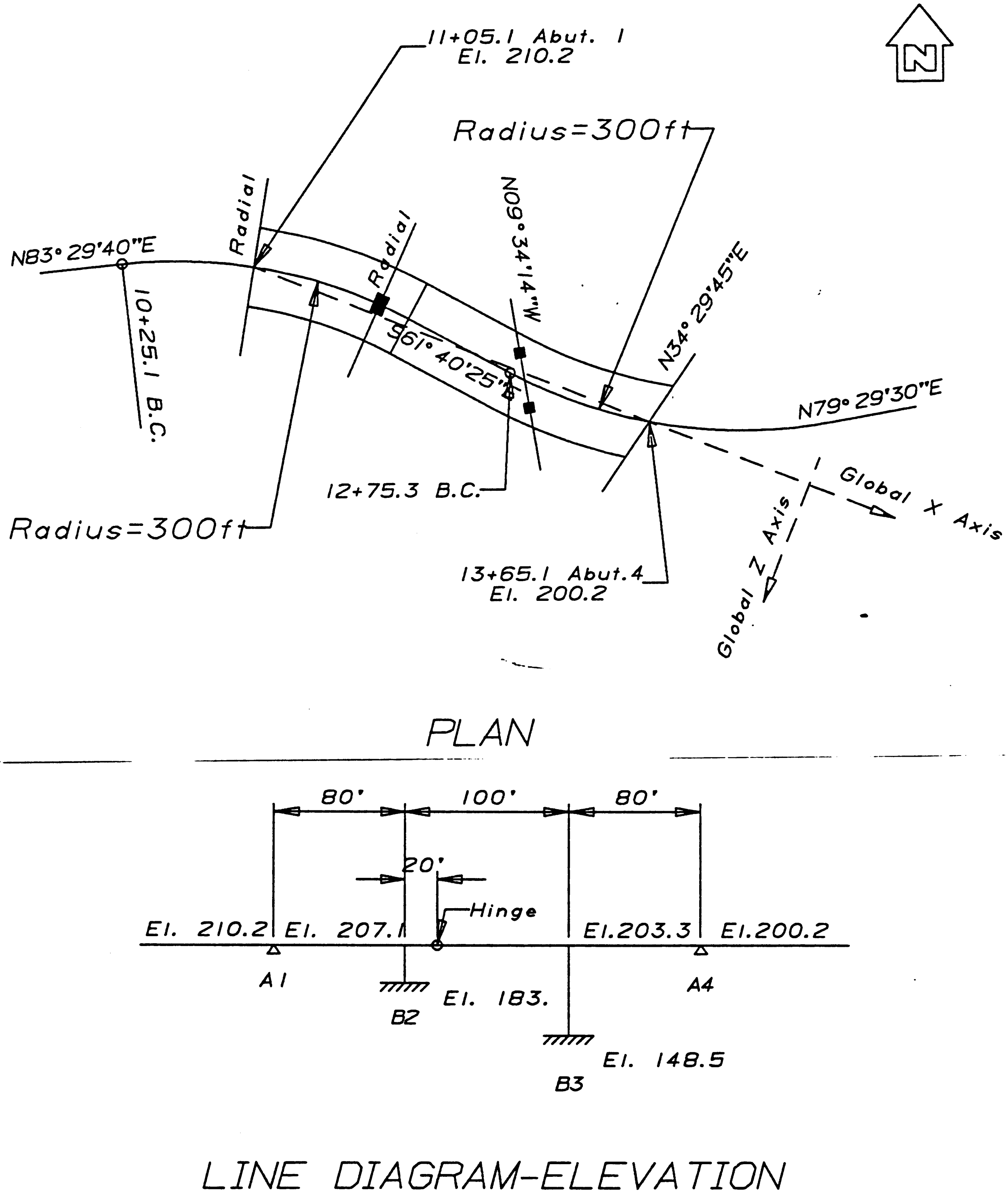


Figure 2

BAG - - EXAMPLE PROBLEM 1

BAG Panel Input

Input Data File

```
|...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8
 1       EXAMPLE PROBLEM           32   481.0001                        1
 2       2N832940ER    300  102510S614025EL    300  127530N792930E      0
 3         11051 2101             0     011 2001N342945E   300   10011
 4        1 800  5100  62000  8090  610   0      0 0    0   0   0   0 500
 4        21000  5100  62000  8090  610   0    20020    31   0 400 240   0
 4        3 800     0      0     0    0   0      0 0    0   0   0   0   0
 5        1         0   0   0 0 00 0  00 0  0 0 0 0 0 0 0
 5        2         0   0   0 0 00 0  00 0  0 0 0 0 0 0 0
 5        3       800 800 600 515012  0012  060 71550 715
 6        2 2070 1830       1    0    0 1 7000 400  3200
 6        3 2032 1485N 93414W 2 2400    0 2 7000 400  3200
 7       1 1   0  150   112   312   450
 7       2 1   0  120    90   160   360
 8        2000      0       0       0       0       0       0
 8        3000      0       0       0       0       0       0
 9       6A      0       0       0       0       0       0
10        1   0   0   0      0      0
10        2   0   0   0      0      0
10        3   0   0   0      0      0
11        2     0     0    0    0    0    0    0    0
11        3     0     0    0    0    0    0    0    0
```

BAG Panel Input Screen 1 - Input

```
*****************************************************************************************
*                                                                                       *
*                                                                                       *
*                                         BAG          V 3.01 RELEASE MAY 18, 1988      *
*       RUN DATA                                                                        *
*                                                                                       *
*        COMMENTS ===>  example problem_________                                        *
*        NOM NJS NJC JMAX NSPX    SF    PLOT ANALYSIS ROTATION REDUCE I/O CONDEN.       *
*        ___  3   2  ___   48   1_____   1        _         _        _        _        *
*                                                                                       *
*       NOM : NO. OF MODES     ( DEFAULT = 12 OR 3 * NO OF SPANS )                      *
*       NJS : NO. OF EXTRA JOINTS ADDED PER SPAN ( DEFAULT =  3 )                       *
*       NJC : NO. OF EXTRA JOINTS ADDED PER COL. ( DEFAULT =  2 )                       *
*       JMAX: MAX. NO. OF JOINTS                 ( DEFAULT = 75 )                       *
*       NSPX: MAX. NO. OF SPANS                  ( DEFAULT = 48 )                       *
*       PLOT: PLOT LENGTH CODE  ( LENGTH = 18 + 6 * PLOT INCHES, 0 FOR NO PLOT)         *
*       ANALYSIS: 0 = STATIC & DYNAMIC , 1 = DYNAMIC ONLY , 2 = STATIC ONLY             *
*       ROTATION: 0 = YES               , 1 = NO                                        *
*    -----------------------------------------------------------------------------      *
*       EARTHQUAKE LOAD DATA                                                            *
*    PEAK :CURVE:     UP TO 6 ADDITIONAL OPTIONAL DIRECTIONS FOR GIVEN LOAD             *
*    ROCK : DES.:           :          :          :          :          :               *
*    ACC. :     :      2    :     3    :     4    :     5    :     6    :     7         *
*   1/10 G: A-D :           :          :          :          :          :               *
*     6     a    _ ______ _ _ ______ _ _ ______ _ _ ______ _ _ ______ _ _ ______ _      *
*    SPECIAL SITE SPECTRUM   ________   (8 CHARACTERS NAME FOR STRUDL)                  *
*                                                                                       *
*                                                                                       *
*****************************************************************************************
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL        *
```

BAG Panel Input Screen 1 - Output

```
*****************************************************************************************
*                                                                                       *
*                                                                                       *
*                                         BAG          V 3.01 RELEASE MAY 18, 1988      *
*       RUN DATA                                                                        *
*                                                                                       *
*        COMMENTS ===>  EXAMPLE PROBLEM                                                 *
*        NOM NJS NJC JMAX NSPX    SF    PLOT ANALYSIS ROTATION                          *
*             3   2        48   1.0000   1                                              *
*                                                                                       *
*       NOM : NO. OF MODES     ( DEFAULT = 12 OR 3 * NO OF SPANS )                      *
*       NJS : NO. OF EXTRA JOINTS ADDED PER SPAN ( DEFAULT =  3 )                       *
*       NJC : NO. OF EXTRA JOINTS ADDED PER COL. ( DEFAULT =  2 )                       *
*       JMAX: MAX. NO. OF JOINTS                 ( DEFAULT = 75 )                       *
*       NSPX: MAX. NO. OF SPANS                  ( DEFAULT = 48 )                       *
*       PLOT: PLOT LENGTH CODE  ( LENGTH = 18 + 6 * PLOT INCHES, 0 FOR NO PLOT)         *
*       ANALYSIS: 0 = STATIC & DYNAMIC , 1 = DYNAMIC ONLY , 2 = STATIC ONLY             *
*       ROTATION: 0 = YES               , 1 = NO                                        *
*    -----------------------------------------------------------------------------      *
*       EARTHQUAKE LOAD DATA                                                            *
*    PEAK :CURVE:     UP TO 6 ADDITIONAL OPTIONAL DIRECTIONS FOR GIVEN LOAD             *
*    ROCK : DES.:           :          :          :          :          :               *
*    ACC. :     :      2    :     3    :     4    :     5    :     6    :     7         *
*   1/10 G: A-D :           :          :          :          :          :               *
*     6     A    _ ______ _ _ ______ _ _ ______ _ _ ______ _ _ ______ _ _ ______ _      *
*    SPECIAL SITE SPECTRUM              (8 CHARACTERS NAME FOR STRUDL)                  *
*                                                                                       *
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL        *
*                                                                                       *
*****************************************************************************************
```

BAG Panel Input Screen 2 - Input

```
********************************************************************************
*                                                                              *
*                                                                              *
*                                   BAG                                        *
*        GEOMETRY DATA                                                         *
*         ORIGIN DATA                          TANGENT OR          ROTATION    *
*                   COORDINATES                 BC TO PI            ANGLE      *
*              Z               X                BEARING           (DEGREES)    *
*          _________      _________          n 832940 e          _________     *
*         CURVE DATA                                                           *
*                CURVE      DIR       RADIUS        BC          BEARING        *
*                 NO.       R/L         FT          FT         PI TO EC        *
*                  1         r        300____    1025.1__    s 614025 e        *
*                  2         l        300____    1275.3__    n 792930 e        *
*                                                                              *
*     ------------------------------------------------------------------------ *
*        ABUTMENT DATA                                                         *
*                                                                              *
*     ABUTMENT  STATION :ELEVATION:   BEARING   :          RELEASE             *
*                 FT    :    FT   :             :        FORCE        : MOMENT *
*                       :         :             :  LONG    TRANS   V :TORSIONAL*
*        1_    1105.1__   210.1__   _ ______ _   ______   ______   1      1    *
*        __               200.1__   n 342945 e   300___   100___   1      1    *
*                                                                              *
*     DESIGN TEMPERATURE RANGE (F) :  ___ DEGREES                              *
*    (TEMPERATURE COEFFCIENT IS BASED ON CONCRETE.  USER SHOULD CHECK STRUDL CODE.) *
*                                                                              *
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL *
*                                                                              *
********************************************************************************
```

BAG Panel Input Screen 2 - Output

```
********************************************************************************
*                                                                              *
*                                                                              *
*                                   BAG                                        *
*        GEOMETRY DATA                                                         *
*         ORIGIN DATA                          TANGENT OR          ROTATION    *
*                   COORDINATES                 BC TO PI            ANGLE      *
*              Z               X                BEARING           (DEGREES)    *
*             0.00            0.00           N 832940 E             0.0000     *
*         CURVE DATA                                                           *
*                CURVE      DIR       RADIUS        BC          BEARING        *
*                 NO.       R/L         FT          FT         PI TO EC        *
*                  1         R          300     1025.10      S 614025 E        *
*                  2         L          300     1275.30      N 792930 E        *
*                                                                              *
*     ------------------------------------------------------------------------ *
*        ABUTMENT DATA                                                         *
*                                                                              *
*     ABUTMENT  STATION :ELEVATION:   BEARING   :          RELEASE             *
*                 FT    :    FT   :             :        FORCE        : MOMENT *
*                       :         :             :  LONG    TRANS   V :TORSIONAL*
*         1      1105.1     210.1   _ ______ _        0        0   1      1    *
*         1                 200.1   N 342945 E      300      100   1      1    *
*                                                                              *
*     DESIGN TEMPERATURE RANGE (F) :     0 DEGREES                             *
*    (TEMPERATURE COEFFCIENT IS BASED ON CONCRETE.  USER SHOULD CHECK STRUDL CODE.) *
*                                                                              *
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL *
*                                                                              *
********************************************************************************
```

BAG Panel Input Screen 3 - Input

```
*********************************************************************************************
*                                                                                           *
*                                                                                           *
*                                                                                           *
*                                             BAG                                           *
*        SPAN DATA - 1                                                                      *
*                                                                                           *
*     SPAN  LENG :MOMENT OF INERTIA  (FT**4):X-AREA       E    STRUCTURE        MASS        *
*      NO.  (FT) :  IZ        IY       IX   :                    DEPTH        ADDITION      *
*                :NORMAL    TRANS     TOR. :(FT**2)     (KSF)    (FT)         (LB/FT)       *
*        1  80___  510____  6200____  809____  61____  _______  5____       ________        *
*        2  100__  510____  6200____  809____  61____  _______  _____       ________        *
*        3  80___  _______  ________  _______  ______  _______  _____       ________        *
*        4  _____  _______  ________  _______  ______  _______  _____       ________        *
*        5  _____  _______  ________  _______  ______  _______  _____       ________        *
*        6  _____  _______  ________  _______  ______  _______  _____       ________        *
*        7  _____  _______  ________  _______  ______  _______  _____       ________        *
*        8  _____  _______  ________  _______  ______  _______  _____       ________        *
*        9  _____  _______  ________  _______  ______  _______  _____       ________        *
*       10  _____  _______  ________  _______  ______  _______  _____       ________        *
*       11  _____  _______  ________  _______  ______  _______  _____       ________        *
*       12  _____  _______  ________  _______  ______  _______  _____       ________        *
*       13  _____  _______  ________  _______  ______  _______  _____       ________        *
*       14  _____  _______  ________  _______  ______  _______  _____       ________        *
*       15  _____  _______  ________  _______  ______  _______  _____       ________        *
*       16  _____  _______  ________  _______  ______  _______  _____       ________        *
*                                                                                           *
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL            *
*                                                                                           *
*********************************************************************************************
```

BAG Panel Input Screen 3 - Output

```
*********************************************************************************************
*                                                                                           *
*                                                                                           *
*                                                                                           *
*                                             BAG                                           *
*        SPAN DATA - 1                                                                      *
*                                                                                           *
*     SPAN  LENG :MOMENT OF INERTIA  (FT**4):X-AREA       E    STRUCTURE        MASS        *
*      NO.  (FT) :  IZ        IY       IX   :                    DEPTH        ADDITION      *
*                :NORMAL    TRANS     TOR. :(FT**2)     (KSF)    (FT)         (LB/FT)       *
*        1   80.0    510.0    6200.0    809.0    61.0        0    5.0              0        *
*        2  100.0    510.0    6200.0    809.0    61.0        0    0.0              0        *
*        3   80.0      0.0       0.0      0.0     0.0        0    0.0              0        *
*        4  _____  _______  ________  _______  ______  _______  _____       ________        *
*        5  _____  _______  ________  _______  ______  _______  _____       ________        *
*        6  _____  _______  ________  _______  ______  _______  _____       ________        *
*        7  _____  _______  ________  _______  ______  _______  _____       ________        *
*        8  _____  _______  ________  _______  ______  _______  _____       ________        *
*        9  _____  _______  ________  _______  ______  _______  _____       ________        *
*       10  _____  _______  ________  _______  ______  _______  _____       ________        *
*       11  _____  _______  ________  _______  ______  _______  _____       ________        *
*       12  _____  _______  ________  _______  ______  _______  _____       ________        *
*       13  _____  _______  ________  _______  ______  _______  _____       ________        *
*       14  _____  _______  ________  _______  ______  _______  _____       ________        *
*       15  _____  _______  ________  _______  ______  _______  _____       ________        *
*       16  _____  _______  ________  _______  ______  _______  _____       ________        *
*                                                                                           *
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL            *
*                                                                                           *
*********************************************************************************************
```

BAG Panel Input Screen 4 - Input

```
***************************************************************************************
*                                                                                     *
*                                                                                     *
*                                     BAG                                             *
*      SPAN DATA -2                                                                   *
*                      : SUPERSTRUCTURE:  SLAB DATA    :  INT. GIRD.                  *
*                 SPAN :      DATA      :  TOP     BOT  :        WEB                  *
*                  NO. :      WIDTH     : THICK   THICK :       THICK.                *
*                      :      (FT)      :  (IN)    (IN) :  NUM   (IN)                 *
*                   1          0.0        0.00    0.00     0      0                   *
*                   2          0.0        0.00    0.00     0      0                   *
*                   3        80          8       6         5     15                   *
*                  __        _____      _____   _____     __     __                   *
*                  __        _____      _____   _____     __     __                   *
*                  __        _____      _____   _____     __     __                   *
*                                                                                     *
*           :          EXTERIOR GIRDERS          :              OVERHANGS             *
*      SPAN:        LEFT        :        RIGHT       :        LEFT         :    RIGHT  *
*       NO.:      W.TH. FACT. :      W.TH.  FACT. : LEN. E.TH. I.TH.: LEN. E.TH. I.TH. *
*          :TYPE  (IN) (FT)  :TYPE  (IN)  (FT) : (FT) (IN)  (IN) : (FT) (IN)  (IN)   *
*        1   0     0  0.00     0     0   0.00    0.0   0     0      0.0   0     0     *
*        2   0     0  0.00     0     0   0.00    0.0   0     0      0.0   0     0     *
*        3        12                12            6    7    15      5     7    15     *
*       __   _    __  ____     _    __   ____   ____  __    __     ____  __    __     *
*       __   _    __  ____     _    __   ____   ____  __    __     ____  __    __     *
*       __   _    __  ____     _    __   ____   ____  __    __     ____  __    __     *
*                                                                                     *
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL      *
*                                                                                     *
***************************************************************************************
```

BAG Panel Input Screen 4 - Output

```
***************************************************************************************
*                                                                                     *
*                                                                                     *
*                                     BAG                                             *
*      SPAN DATA -2                                                                   *
*                      : SUPERSTRUCTURE:  SLAB DATA    :  INT. GIRD.                  *
*                 SPAN :      DATA      :  TOP     BOT  :        WEB                  *
*                  NO. :      WIDTH     : THICK   THICK :       THICK.                *
*                      :      (FT)      :  (IN)    (IN) :  NUM   (IN)                 *
*                   1          0.0        0.00    0.00     0      0                   *
*                   2          0.0        0.00    0.00     0      0                   *
*                   3         80.0        8.00    6.00     5     15                   *
*                  __        _____      _____   _____     __     __                   *
*                  __        _____      _____   _____     __     __                   *
*                  __        _____      _____   _____     __     __                   *
*                                                                                     *
*           :          EXTERIOR GIRDERS          :              OVERHANGS             *
*      SPAN:        LEFT        :        RIGHT       :        LEFT         :    RIGHT  *
*       NO.:      W.TH. FACT. :      W.TH.  FACT. : LEN. E.TH. I.TH.: LEN. E.TH. I.TH. *
*          :TYPE  (IN) (FT)  :TYPE  (IN)  (FT) : (FT) (IN)  (IN) : (FT) (IN)  (IN)   *
*        1   0     0  0.00     0     0   0.00    0.0   0     0      0.0   0     0     *
*        2   0     0  0.00     0     0   0.00    0.0   0     0      0.0   0     0     *
*        3   0    12  0.00     0    12   0.00    6.0   7    15      5.0   7    15     *
*       __   _    __  ____     _    __   ____   ____  __    __     ____  __    __     *
*       __   _    __  ____     _    __   ____   ____  __    __     ____  __    __     *
*       __   _    __  ____     _    __   ____   ____  __    __     ____  __    __     *
*                                                                                     *
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL      *
*                                                                                     *
***************************************************************************************
```

BAG Panel Input Screen 5 - Input

```
*******************************************************************************
*                                                                             *
*                                                                             *
*                                                                             *
*                                   BAG                                       *
*      SPAN DATA - 3                                                          *
*                                                                             *
*   SPAN :----------- HINGE ---------:------ RESTRAINER-----:  WIND   WIND    LL   *
*    NO. :LOCATION  X-SECTION LENGTH : LENGTH  AREA     E   :  LOAD   ON LL   LF   *
*        :  (FT)     (FT**2)   (FT)  :  (FT)  (IN**2) (KSF) : (KLF)  (KLF)  (KLF)  *
*     1       0.0      0.00     0.0      0.0    0.0      0      0      0      0    *
*     2    20        40        24       20     3.1       0      0      0      0    *
*     3       0.0      0.00     0.0      0.0    0.0      0      0      0      0    *
*     4   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*     5   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*     6   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*     7   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*     8   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*     9   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*    10   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*    11   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*    12   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*    13   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*    14   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*    15   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*    16   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*                                                                             *
*  F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL  *
*                                                                             *
*******************************************************************************
```

BAG Panel Input Screen 5 - Output

```
*******************************************************************************
*                                                                             *
*                                                                             *
*                                                                             *
*                                   BAG                                       *
*      SPAN DATA - 3                                                          *
*                                                                             *
*   SPAN :----------- HINGE ---------:------ RESTRAINER-----:  WIND   WIND    LL   *
*    NO. :LOCATION  X-SECTION LENGTH : LENGTH  AREA     E   :  LOAD   ON LL   LF   *
*        :  (FT)     (FT**2)   (FT)  :  (FT)  (IN**2) (KSF) : (KLF)  (KLF)  (KLF)  *
*     1       0.0      0.00     0.0      0.0    0.0      0  0.000  0.000  0.000    *
*     2      20.0     40.00    24.0     20.0    3.1      0  0.000  0.000  0.000    *
*     3       0.0      0.00     0.0      0.0    0.0      0  0.000  0.000  0.000    *
*     4   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*     5   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*     6   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*     7   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*     8   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*     9   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*    10   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*    11   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*    12   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*    13   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*    14   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*    15   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*    16   ______   ______   ______   ______ ______ ______ ______ ______ ______    *
*                                                                             *
*  F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL  *
*                                                                             *
*******************************************************************************
```

BAG Panel Input Screen 6 - Input

```
********************************************************************************
*                                                                              *
*                                                                              *
*                                                                              *
*                                    BAG                                       *
*      BENT DATA - 1                                                           *
*                                                                              *
*   BENT:   ELEVATION  :          :NO.  C-C      E    : COL. :  ------ CAP -------  *
*       : TOP   BOTTOM :  BEARING :OF   COL           :      :   IZ     AREA   LENG *
*    NO.: (FT)    (FT) :          :COL. (FT)   (KSF)  : TYPE :(FT**4) (FT**2)  (FT) *
*     2 207     183                  1                   1      700     40     32   *
*     3 203.2   148.5   N  93414 W  2   24               2      700     40     32   *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*                                                                              *
*   F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL   *
*                                                                              *
********************************************************************************
```

BAG Panel Input Screen 6 - Output

```
********************************************************************************
*                                                                              *
*                                                                              *
*                                                                              *
*                                    BAG                                       *
*      BENT DATA - 1                                                           *
*                                                                              *
*   BENT:   ELEVATION  :          :NO.  C-C      E    : COL. :  ------ CAP -------  *
*       : TOP   BOTTOM :  BEARING :OF   COL           :      :   IZ     AREA   LENG *
*    NO.: (FT)    (FT) :          :COL. (FT)   (KSF)  : TYPE :(FT**4) (FT**2)  (FT) *
*     2  207.0   183.0  _ _____  _  1   0.0        0     1    700.0   40.0   32.0  *
*     3  203.2   148.5  N  93414 W  2  24.0        0     2    700.0   40.0   32.0  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*    __ _____   _____  _ _____  _ __ ___   _____         _     _____   ____   ____  *
*                                                                              *
*   F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL   *
*                                                                              *
********************************************************************************
```

BAG Panel Input Screen 7 - Output

```
******************************************************************************************
*                                                                                        *
*                                                                                        *
*                                                                                        *
*                                        BAG                                             *
*       BENT DATA - 2                                                                    *
*                                                                                        *
*         BENT: WIND ON COLUMN  :              CENTRIFUGAL FORCE                         *
*             :   LONG    TRANS :------- H LOAD ------:----- P LOAD -------              *
*          NO.:  (KLF)    (KLF) :  TRANS   LONG     N    TRANS   LONG     N              *
*           2       0.0     0.0       0      0      0      0       0      0              *
*           3       0.0     0.0       0      0      0      0       0      0              *
*          __  _______  _______   _____  _____  _____  _____  _____  _____               *
*          __  _______  _______   _____  _____  _____  _____  _____  _____               *
*          __  _______  _______   _____  _____  _____  _____  _____  _____               *
*          __  _______  _______   _____  _____  _____  _____  _____  _____               *
*          __  _______  _______   _____  _____  _____  _____  _____  _____               *
*          __  _______  _______   _____  _____  _____  _____  _____  _____               *
*          __  _______  _______   _____  _____  _____  _____  _____  _____               *
*          __  _______  _______   _____  _____  _____  _____  _____  _____               *
*          __  _______  _______   _____  _____  _____  _____  _____  _____               *
*          __  _______  _______   _____  _____  _____  _____  _____  _____               *
*          __  _______  _______   _____  _____  _____  _____  _____  _____               *
*          __  _______  _______   _____  _____  _____  _____  _____  _____               *
*          __  _______  _______   _____  _____  _____  _____  _____  _____               *
*          __  _______  _______   _____  _____  _____  _____  _____  _____               *
*                                                                                        *
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL         *
*                                                                                        *
******************************************************************************************
```

BAG Panel Input Screen 8 - Output

```
******************************************************************************************
*                                                                                        *
*                                                                                        *
*                                                                                        *
*                                          BAG                                           *
*       BENT DATA - 3                                                                    *
*                                                                                        *
*    BENT :--TOP OF COLUMN--:--------- FOUNDATION SPRING ON LOCAL AXES ------------      *
*     NO. : MOMENT RELEASE  :        TRANSLATION         :           ROTATION            *
*         :    Z    Y    X  :Z (TRANS)    X     Y (LONG): Z (LONG) X (TOR)  Y (TRAN)     *
*     33       0    0    0          0         0        0         0        0        0     *
*     34       0    0    0          0         0        0         0        0        0     *
*     __       _    _    _  ________ ________ ________  ________ ________ ________       *
*     __       _    _    _  ________ ________ ________  ________ ________ ________       *
*     __       _    _    _  ________ ________ ________  ________ ________ ________       *
*     __       _    _    _  ________ ________ ________  ________ ________ ________       *
*     __       _    _    _  ________ ________ ________  ________ ________ ________       *
*     __       _    _    _  ________ ________ ________  ________ ________ ________       *
*     __       _    _    _  ________ ________ ________  ________ ________ ________       *
*     __       _    _    _  ________ ________ ________  ________ ________ ________       *
*     __       _    _    _  ________ ________ ________  ________ ________ ________       *
*     __       _    _    _  ________ ________ ________  ________ ________ ________       *
*     __       _    _    _  ________ ________ ________  ________ ________ ________       *
*     __       _    _    _  ________ ________ ________  ________ ________ ________       *
*     __       _    _    _  ________ ________ ________  ________ ________ ________       *
*     __       _    _    _  ________ ________ ________  ________ ________ ________       *
*                                                                                        *
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL         *
*                                                                                        *
******************************************************************************************
```

BAG Panel Input Screen 9 - Input

```
********************************************************************************
*                                                                              *
*                                                                              *
*                                                                              *
*                                    BAG                                       *
*      COLUMN DATA                                                             *
*                                                                              *
*       STORE :                   SEGMENT                                      *
*       COLUMN:        LENGTH  AREA    :   MOMENT OF INERTIA (FT**4)           *
*         TYPE : NO.    (FT)  (FT**2) :IZ(LONGIT)  IY(TRANS)  IX(TOR)          *
*          1    1_     _____  15____    11.2___    31.2___    45_____          *
*          2    1_     _____  12____    9______    16_____    36_____          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*                                                                              *
*   F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL *
*                                                                              *
********************************************************************************
```

BAG Panel Input Screen 9 - Output

```
********************************************************************************
*                                                                              *
*                                                                              *
*                                                                              *
*                                    BAG                                       *
*      COLUMN DATA                                                             *
*                                                                              *
*       STORE :                   SEGMENT                                      *
*       COLUMN:        LENGTH  AREA    :   MOMENT OF INERTIA (FT**4)           *
*         TYPE : NO.    (FT)  (FT**2) :IZ(LONGIT)  IY(TRANS)  IX(TOR)          *
*          1    1        0.0    15.0        11.2       31.2     45.0           *
*          2    1        0.0    12.0         9.0       16.0     36.0           *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*          _    _      _____  ______    _______    _______    _______          *
*                                                                              *
*   F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL *
*                                                                              *
********************************************************************************
```

BAG Output

(BAG output is STRUDL input)

```
 STRUDL '        ' 'EXAMPLE PROBLEM         '
 DEBUG ALL & SCAN CONDITIONAL
 REORG 5
$                       BBBBBBB      A       GGGGGG
$                       BBBBBBBB    AAA     GGGGGGGG
$                       BB    BB   AA AA    GG    GG
$                       BB    BB  AA   AA   GG
$                       BB    BB  AA   AA   GG
$                       BBBBBBB   AAAAAAA   GG
$                       BB    BB  AAAAAAA   GG  GGGGGG
$                       BB    BB  AA   AA   GG  GGGGGG
$                       BB    BB  AA   AA   GG    GG
$                       BBBBBBBB  AA   AA   GGGGGGGG
$                       BBBBBBB   AA   AA   GGGGGG
$ ******************************************************************
$ THE STRUDL CODING FOR THIS ANALYSIS WAS COMPUTER GENERATED USING
$ BAG(PRODUCTION) MOD 21  6.27.90
$ THE FOLLOWING INPUT AND GENERATED STRUDL CODING
$ SHOULD BE VERIFIED TO BE SURE THE GENERATED MODEL IS VALID
$
$ ****************  G E O M E T R Y   D A T A ********************
$
$ CURVE DIR
$ 0=R  1=L    RADIUS   BC STA    TAN AZIMUTH
$                                  61.9764
$   0          300.   1025.10     96.8083
$   1          300.   1275.30     57.9736
$
$ *****************  A B U T M E N T   D A T A *****************
$
$                                ******** RELEASES ************
$ ABUT   STA     ELEV   AZIMUTH  LONG F  TRANS F  VERT F  TORSION
$  1    1105.1  210.1  347.2551      0       0      1        1
$  4             200.1   12.9779    300     100      1        1
$
$ *****************  S P A N   D A T A **************
$
$   SPAN       IZ      IY       IX      AX    MODULUS  STRUCTURE DEPTH
$  1  80.0   510.0  6200.0   809.0   61.0      468000.    5.00
$  2 100.0   510.0  6200.0   809.0   61.0      468000.    5.00
$  3  80.0   462.4 60951.2  1461.7  122.9      468000.    5.00
$
$ *********S T A T I C   L O A D   D A T A ********
$
$     SPAN      W         WL        LF     UMASS     TEMP
$       1     1.000     0.100     1.000       0.      35.
$       2     1.000     0.100     1.000       0.
$       3     1.000     0.100     1.000       0.
$
$ *****************  H I N G E   D A T A **********************
$
$              **** RESTRAINER DATA ********** HINGE   DATA  ********
$ SPAN HINGE   LENGTH   AREA  MODULUS          AREA   LENGTH
$   2   20.0    20.0     3.1  1440000.00        40.0      24.00
$
$ ****************  B E N T   D A T A ************************
$
$      ELEVATIONS             NO  C-C  COL          CAP DATA
$ BT   TOP   FTG    AZIMUTH COL COL MODULUS COL    IZ      AX     CAP LT.
$  2  207.0  183.0    2.5339 1  0.0  468000.  1  700.0    40.0   32.0
$  3  203.2  148.5  328.9114 2 24.0  468000.  2  700.0    40.0   32.0
```

```
$
$ ****************   B E N T   . R E L E A S E S   *****************
$
$   BENT                   FORCE RELEASES
$          MOM REL TOP         FOR REL FTG        MOM REL FTG
$     2     1 1 1        1        1        1        1        1        1
$     3     1 1 1        1        1        1        1        1        1
$
$ *********** CENTRIFUGAL    FORCE    DATA  *****   COL  WIND   FORCE  *****
$
$ BT   CFH1   CFH2   CFH3   CFP1   CFP2   CFP3       CWFL        CWFT
$  2    0.     0.     0.     0.     0.     0.       1.000       1.000
$  3    0.     0.     0.     0.     0.     0.       1.000       1.000
$
$ ****************   C O L U M N    D A T A  ***************************
$
$ TYPE  SEG    L    AREA      IZ      IY      IX
$  1     1    0.0   15.0     11.2    31.2    45.0
$  2     1    0.0   12.0      9.0    16.0    36.0
$
$ ****************   R U N      D A T A  ********************************
$
$      EXTRA JOINTS
$       SPAN   COL   MAX SPANS  TOTAL JOINTS  MAX JOINTS  SPEC MOD F  PLOT COND
$        3      2       48           28            75       1.0000       1  1
$
$ THE STRUCTURE HAS BEEN ROTATED   -21.5180 DEGREES (CLOCKWISE = + )
$ FROM THE INPUT LOCATION TO PERMIT SEISMIC LOADS TO BE APPLIED
$ IN THE GLOBAL X AND Z DIRECTIONS
$
$ ********************************************************************
 TYPE SPACE FRAME
 UNITS FEET KIPS DEGREES LBM
$
$                JOINT NUMBER KEY
$      JOINT      DIGIT 1  DIGITS 2,3  DIGIT 4   DIGIT 5
$  ============== ======= =========== ========= =========
$  SUPERSTRUCTURE    1      SPAN NO.  JOINT NO.   -----
$      HINGE         2      SPAN NO.  JOINT NO.   -----
$    ABUTMENT        3    SUPPORT NO. JOINT NO.   -----
$     COLUMN         4      BENT NO.   COL. NO.  JOINT NO.
$
 JOINT COORDINATES
$   JOINT        X          Y          Z
$      SUPERSTRUCTURE
$
$ ADDITIONAL COORDINATES TO BE USED FOR THE PHASE2 RETROFIT - TENSION MODEL ONLY
$ COORDINATES MUST BE PROVIDED BY THE ENGINEER
$
$     3001       0.00       0.00       0.00    SUPPORT   $  TENSION MODEL ONLY
$     3051       0.00       0.00       0.00    SUPPORT   $  TENSION MODEL ONLY
      3011  10000.00     210.10   10000.00    SUPPORT
      1012  10000.97     210.06    9999.78
      1013  10020.37     209.32    9996.12
      1014  10039.98     208.55    9993.75
      1015  10059.70     207.77    9992.68
      1021  10079.44     207.00    9992.90
      2022  10099.38     206.24    9994.45
      2023  10100.37     206.20    9994.56
      1024  10119.98     205.46    9996.89
      1025  10139.60     204.72    9999.23
      1026  10159.21     203.98   10001.58
      1031  10178.83     203.24   10003.76
      1032  10198.55     202.43   10004.81
      1033  10218.29     201.67   10004.56
      1034  10237.98     200.90   10003.02
      1035  10257.52     200.14   10000.17
      3041  10258.50     200.10   10000.00    SUPPORT
$     COLUMN/S
```

```
    40211  10079.44    183.00    9992.90    SUPPORT
    40212  10079.44    191.00    9992.90
    40213  10079.44    199.00    9992.90
    40311  10172.63    148.50    9993.48    SUPPORT
    40312  10172.63    166.73    9993.48
    40313  10172.63    184.97    9993.48
    40314  10172.63    203.20    9993.48
    40321  10185.02    148.50   10014.03    SUPPORT
    40322  10185.02    166.73   10014.03
    40323  10185.02    184.97   10014.03
    40324  10185.02    203.20   10014.03
$
$             MEMBER NUMBER KEY
$     MEMBER        DIGIT 1  DIGITS 2,3  DIGIT 4   DIGIT 5
$ ============== ======= =========== ========= =========
$ SUPERSTRUCTURE     5      SPAN NO.   MEM. NO.   -----
$       CAP          6      BENT NO.   MEM. NO.   -----
$     COLUMN         7      BENT NO.   COL. NO.  MEM. NO.
$   RESTRAINER       8      SPAN NO.   -------    -----
$
 MEMBER INCIDENCES
$ MEMBER   START    END
$       SUPERSTRUCTURE
 MEMBER INCIDENCES
    5011     3011     1012
    5012     1012     1013
    5013     1013     1014
    5014     1014     1015
    5015     1015     1021
    5021     1021     2022
    5022     2022     2023
    5023     2023     1024
    5024     1024     1025
    5025     1025     1026
    5026     1026     1031
    5031     1031     1032
    5032     1032     1033
    5033     1033     1034
    5034     1034     1035
    5035     1035     3041
 TYPE SPACE TRUSS
 MEMBER INCIDENCES
     802     1021     1024
$    RESTRAINER/S
$
$ ADD RESTRAINERS AT ABUTMENTS FOR USE IN THE PHASE2 RETROFIT-TENSION MODEL ONLY
$
$    800     3001     1013     $  TENSION MODEL ONLY
$    803     1034     3051     $  TENSION MODEL ONLY
 TYPE SPACE FRAME
 MEMBER INCIDENCES
$      COLUMN/S
   70211    40211    40212
   70212    40212    40213
   70213    40213     1021
   70311    40311    40312
   70321    40321    40322
   70312    40312    40313
   70322    40322    40323
   70313    40313    40314
   70323    40323    40324
$       CAP/S
    6031    40314     1031
    6032     1031    40324
$
$ SUPERSTRUCTURE MEMBERS
$
 GROUP     '/GP/SUPE'    DEFINITION
 MEMB 5011 THRU   5015
```

```
 MEMB 5021 THRU   5026
 MEMB 5031 THRU   5035
 END    GROUP DEFINITION
$  SUPERSTRUCTURE MEMBER PROPERTIES
 MEMBER PROPERTIES PRISMATIC
 5011 THRU 5015 AX   61.0 IX      809.0 IY     6200.0 IZ      510.0
 5021 THRU 5026 AX   61.0 IX      809.0 IY     6200.0 IZ      510.0
 5031 THRU 5035 AX  122.9 IX     1461.7 IY    60951.2 IZ      462.4
$
$ COLUMN MEMBERS
$
 GROUP  '/GP/COLS'    DEFINITION
 MEMB      70211      THRU     70213
 MEMB      70311      THRU     70313
 MEMB      70321      THRU     70323
 END    GROUP DEFINITION
$ COLUMN MEMBER PROPERTIES
 MEMB PROP PRIS AX   15.0 IX       45.0 IY       31.2 IZ       11.2
 70211
 MEMB PROP PRIS AX   15.0 IX       45.0 IY       31.2 IZ       11.2
 70212
 MEMB PROP PRIS AX   15.0 IX       45.0 IY       31.2 IZ       11.2
 70213
 MEMB PROP PRIS AX   12.0 IX       36.0 IY       16.0 IZ        9.0
 70311 70321
 MEMB PROP PRIS AX   12.0 IX       36.0 IY       16.0 IZ        9.0
 70312 70322
 MEMB PROP PRIS AX   12.0 IX       36.0 IY       16.0 IZ        9.0
 70313 70323
$
$ CAP MEMBERS
$
 GROUP  '/GP/CAPS'    DEFINITION
 MEMB 6031 THRU   6032
 END  GROUP DEFINITION
$ CAP MEMBER PROPERTIES
 MEMBER PROPERTIES PRISMATIC
 6031 THRU 6032 AX   40.0 IX   700000.0 IY   700000.0 IZ      700.0
$ RESTRAINER MEMBER PROPERTIES
 802 AX   0.0439
$
$ AREA OF ADDED RESTRAINERS FOR THE PHASE2 RETROFIT AT THE  ABUTMENTS FOR THE
$    TENSION ONLY MODEL
$
 MEMBER PROPERTIES PRISMATIC
$       800    AX      0.     $  TENSION ONLY MODEL ADD RESTRAINER AREA
$       803    AX      0.     $  TENSION ONLY MODEL ADD RESTRAINER AREA
$
 CONSTANTS
 DENSITY 150.0 ALL
 G 172800. ALL
 CTE 0.0000065 ALL
$ SUPERSTRUCTURE MODULUS OF ELASTICITY
 E   468000.  5011 THRU  5015
 E   468000.  5021 THRU  5026
 E   468000.  5031 THRU  5035
$ COLUMN/S MODULUS OF ELASTICITY
 E   468000. 70211 THRU 70213
 E   468000. 70311 THRU 70313
 E   468000. 70321 THRU 70323
$  CAP/S MODULUS OF ELASTICITY
 E   468000.  6031 THRU  6032
$ RESTRAINER MODULUS OF ELASTICITY
$
$ MODULUS OF ELASTICITY FOR THE ADDED RESTRAINERS FOR THE PHASE2 RETROFIT AT THE
$  ABUTMENTS FOR THE TENSION ONLY MODEL
$
 E  1440000.    802
$
```

```
$ E  1440000.    800     $  TENSION ONLY MODEL
$ E  1440000.    803     $  TENSION ONLY MODEL
$ BETA ANGLES FOR COLUMNS
 BETA   -2.5339 70211 THRU 70213
 BETA   31.0886 70311 THRU 70313
 BETA   31.0886 70321 THRU 70323
$  ABUTMENT   1  RELEASES
$
$ MEMBER RELEASE REQUIRED FOR THE TENSION ONLY MODEL
$
 MEMBER 5011 REL END FOR X  Z
  JOINT 3011 RELEASE           MOM    Y  Z  -
  TH2   -12.7449
$  ABUTMENT   4  RELEASES
$
$ MEMBER RELEASE REQUIRED FOR THE TENSION ONLY MODEL
$
$ MEMBER 5035 REL  STA FOR X     $  TESION ONLY MODEL
$
  JOINT 3041 RELEASE           MOM    Y  Z  -
  TH2    12.9778 KFX      3600. KFZ      1200.
$   HINGE  RELEASES
 MEMBER 5022 RELEASES END FORCE X MOMENT   Y Z
$   COLUMN RELEASES
$ COLUMN MEMBER END JOINT SIZE
 MEMBER END JOINT SIZE
  MEMBER   70213  END SIZE END      2.50
  MEMBER   70313  END SIZE END      2.50
  MEMBER   70323  END SIZE END      2.50
$
$ REMOVE MEMBER RELEASES FORCE X AT ABUTMENTS AND HINGES FOR THE COMPRESSION
$ MODEL
$
$ INACTIVATE RESTRAINERS AT HINGES AND ABUTMENTS WHEN USING THE
$     COMPRESSION ONLYMODEL
$
$ INACTIVE JOINT  3001  3051     $  COMPRESSION ONLY MODEL
$ INACTIVE MEMBERS   802     $  COMPRESSION ONLY MODEL
$ INACTIVE MEMBERS   800     $  COMPRESSION ONLY MODEL
$ INACTIVE MEMBERS   803     $  COMPRESSION ONLY MODEL
 INERTIA OF JOINTS LUMPED
$ HINGE WEIGHT
 INERTIA OF JOINTS ADD
     2022    LINEAR ALL           72000.00
     2023    LINEAR ALL           72000.00
$ CAP WEIGHT
 INERTIA OF JOINTS ADD
     1021    LINEAR ALL          192000.00
    40314    LINEAR ALL           24000.00
    40324    LINEAR ALL           24000.00
 DAMPING PERCENTS  5.0   12
 SHOCK SPECTRUM LOAD ' Z DIR' 'EXAMPLE PROBLEM         '
 SPECTRUM TRANSLATION Z  1.000 X  0.000 FILE 'S.6GA51' FACTOR 1.0000
 END OF DYNAMIC LOAD
 SHOCK SPECTRUM LOAD ' X DIR' 'EXAMPLE PROBLEM         '
 SPECTRUM TRANSLATION Z  0.000 X  1.000 FILE 'S.6GA51' FACTOR 1.0000
 END OF DYNAMIC LOAD
 LOAD ' TRANS'
 CQC LOAD ' Z DIR'
 LOAD 'LONGIT'
 CQC LOAD ' X DIR'
 LOAD COMB 'CASE 1' 'TRANS PLUS 0.3 TIMES LONGIT       CQC'
 LOAD COMB 'CASE 2' 'LONGIT PLUS 0.3 TIMES TRANS       CQC'
 LOAD ' TRANSC'
 PRINT STRUCTURAL DATA
 DEFINE INERTIA WEIGHT LOAD 'D' WITH FACTORS  LINEAR Y  -1.
  LOADING LIST  'D'
 STIFFNESS ANALYSIS REDUCE BAND
  OUTPUT DECIMAL  5
```

```
 LIST DISPLACEMENTS ALL
 UNITS INCHES
 PLOT DEVICE PLOTTER PAPER 30
 PLOT FORMAT ORIENTATION NON STANDARD   12.8
 LABEL JOINTS
 TITLE 'EXAMPLE PROBLEM         '
 TITLE BLOCK
 JOB 'EXAMPLE PROBLEM         '
 FOR '        '
 BY '  BAG  '
 DISPLAY THREE DIMENSIONAL
 PLOT FINISH
 UNITS FEET
 STATISTICS PARAMETERS
 INERTIA MATRIX LUMPED
 KINEMATIC CONDENSATION INDEPENDENT     72
 MODAL ANALYSIS     12
 STATISTICS ANALYSIS REDUCE BAND
 END STATISTICS
 ASSEMBLE FOR DYNAMICS REDUCE BAND
 INDEPENDENT DEGREE OF FREEDOM SELECT
 CONDENSE DYNAMIC MATRICES
 DUMP ORTHOGONALITY
 MODAL ANALYSIS HOW  12
 LIST DYNAMIC NORMALIZED EIGENVECTORS
 LIST DYNAMIC PARTICIPATION FACTORS
$  LIST DYNAMIC NORMALIZED EIGENVECTORS BY JOINT -
$   3011 1012 1021 2022 2023 1031 1035 3041
 SHOCK SPECTRUM ANALYSIS LOAD  ' Z DIR'   ' X DIR'
 GENERATE RESULTS FOR LOADS ' TRANS' 'LONGIT'
 COMBINE 'CASE 1' ' TRANS' 1.0 'LONGIT' 0.3
 COMBINE 'CASE 2' 'LONGIT' 1.0 ' TRANS' 0.3
 LOAD LIST 'CASE 1' 'CASE 2'
 OUTPUT DECIMAL 1
$ LIST ELASTIC COL MEM FORCES (A*R*S LOAD)
 LIST FORCES MEMBERS -
 70211 70213 -
 70311 70313 -
 70321 70323
$ LIST ELAS. RESTRAINER FORCES (A*R*S LOAD)
 LIST FORCES MEMBERS -
  802
$
$ LIST FORCES DIST MEMS -
$ 800      $  TENSION ONLY MODEL
$ 803      $  TENSION ONLY MODEL
$ LIST ELAS. GLOBAL DISP FOR MAJOR JOINTS (A*R*S LOAD)
 OUTPUT DECIMAL 4
 LIST DISPLACEMENTS JOINTS -
 3011 1012 1021 2022 2023 1031 1035 3041
 OUTPUT DECIMAL 1
$ LIST ELAS MEM FORCES AT ABUTS AND HINGES (A*R*S LOAD)
 LIST FORCES MEMBERS -
 5011 5022 5035
 FINISH
 LOAD LIST   ' Z DIR'   ' X DIR'
 OUTPUT DECIMAL 4
 LIST DYNAMIC MODAL SHOCK SPECT FORCES MEMS -
 70211 70213 -
 70311 70313 -
 70321 70323
 LIST DYNAMIC MODAL SHOCK SPECT DISP JOINTS -
 3011 1012 1021 2022 2023 1031 1035 3041
 LIST DYNAMIC MODAL SHOCK SPECT FORCES DIST MEMS -
  802
$
$ LIST DYNAMIC MODAL SHOCK SPECT FORCES DIST MEMS -
$ 800      $  TENSION ONLY MODEL
```

```
$ 803     $  TENSION ONLY MODEL
$ LIST MODAL MEM FORCES AT ABUTS AND HINGES
 LIST DYNAMIC MODAL SHOCK SPECT FORCES MEMS -
 5011 5022 5035
 FINISH
  CHANGES
  JOINT 3041 REL MOMENT   Y    Z  -
           KFX  1.0     KFZ  1.0
  ADDITIONS
 PRINT JOINT RELEASES
$ BRIDGES WITH SHARP RADIUS CURVES(CURVES LESS THAN OR EQUAL
$ TO 1000.0 FEET) MAY GIVE A STATIC CHECK UNBALANCE MESSAGE.
$ IGNORE THIS MESAGE AS THE RESULTS OF THE STATICS RUN ARE
$ SATISFACTORY.
$
 INACTIVE MEMBERS -
 802
$   800    $  TENSION MODEL ONLY
$   803    $  TENSION MODEL ONLY
 LOADING   'W'     'WIND LOAD ON STRUCTURE'
 MEMBER LOADS
          5011  THRU   5015  FORCE  Z  GLOBAL PROJ UNI  W     1.000
          5021  THRU   5026  FORCE  Z  GLOBAL PROJ UNI  W     1.000
          5031  THRU   5035  FORCE  Z  GLOBAL PROJ UNI  W     1.000
          5011  THRU   5015  FORCE  X              UNI  W     0.240
          5021  THRU   5026  FORCE  X              UNI  W     0.240
          5031  THRU   5035  FORCE  X              UNI  W     0.240
         70211  THRU  70213  FORCE  Z  GLOBAL PROJ UNI  W     1.000
         70311  THRU  70313  FORCE  Z  GLOBAL PROJ UNI  W     1.000
         70321  THRU  70323  FORCE  Z  GLOBAL PROJ UNI  W     1.000
         70211  THRU  70213  FORCE  X  GLOBAL PROJ UNI  W     1.000
         70311  THRU  70313  FORCE  X  GLOBAL PROJ UNI  W     1.000
         70321  THRU  70323  FORCE  X  GLOBAL PROJ UNI  W     1.000
 LOADING   'WL'     'WIND LOAD ON LIVE LOAD'
 MEMBER LOADS
          5011  THRU   5015  FORCE  Z  GLOBAL PROJ UNI  W     0.100
          5011  THRU   5015  MOM    X  GLOBAL PROJ UNI  W     0.850
          5021  THRU   5026  FORCE  Z  GLOBAL PROJ UNI  W     0.100
          5021  THRU   5026  MOM    X  GLOBAL PROJ UNI  W     0.850
          5031  THRU   5035  FORCE  Z  GLOBAL PROJ UNI  W     0.100
          5031  THRU   5035  MOM    X  GLOBAL PROJ UNI  W     0.850
          5011  THRU   5015  FORCE  X              UNI  W     0.040
          5011  THRU   5015  MOM    Z              UNI  W     0.340
          5021  THRU   5026  FORCE  X              UNI  W     0.040
          5021  THRU   5026  MOM    Z              UNI  W     0.340
          5031  THRU   5035  FORCE  X              UNI  W     0.040
          5031  THRU   5035  MOM    Z              UNI  W     0.340
 LOADING   'LF'     'LONGITUDINAL FORCE     '
 MEMBER LOADS
          5011  THRU   5015  FORCE  X              UNI  W     1.000
          5011  THRU   5015  MOM    Z              UNI  W     8.500
          5021  THRU   5026  FORCE  X              UNI  W     1.000
          5021  THRU   5026  MOM    Z              UNI  W     8.500
          5031  THRU   5035  FORCE  X              UNI  W     1.000
          5031  THRU   5035  MOM    Z              UNI  W     8.500

$
  LOADING   'T'     'TEMPERATURE LOAD'
  MEMBER TEMPERATURE LOADS
  '/GP/SUPE'  AXIAL    35.
  '/GP/COLS'  AXIAL    35.
  '/GP/CAPS'  AXIAL    35.
$
$ FOR BENT   2
$
$
  LOADING  'DY -    2'   'TRANS MOMENT DISTRIBUTION'
$ FOR SINGLE COLUMN BENTS USE THE FOLLOWING COMMAND (ADD + 1 OR - 1 TO
$ THE ANSWER)
```

```
  MEMBER    70213  END LOAD END   MOMENT Y 1.0
$
  LOADING  'DX -   2'  'LONGIT MOMENT DISTRIBUTION'
$ FOR SINGLE COLUMN BENTS USE THE FOLLOWING COMMAND (ADD + 1 OR - 1 TO
$ THE ANSWER)
  MEMBER    70213  END LOAD END   MOMENT Z 1.0
$
$ FOR BENT   3
$
$
  LOADING  'DY -   3'   'TRANS MOMENT DISTRIBUTION'
  MEMBER   6031  END LOAD START MOMENT Z 1.0
$
  LOADING  'DX -   3'  'LONGIT MOMENT DISTRIBUTION'
  MEMBER   6031  END LOAD START MOMENT X 1.0
 STIFFNESS ANALYSIS REDUCE BAND
$  THE COMMAND ABOVE LISTS ALL RESULTS
  OUTPUT DECIMAL       2
$  THE FOLLOWING COMMANDS REFORMAT THE COLUMN FORCES ONLY
  OUTPUT BY MEMBER
$ LIST COLUMN MEMBER FORCES
 LOADING LIST   'CASE 1'  'CASE 2'  'W'   'WL'   'LF' 'T' 'DY -   2', -
'DX -   2' 'CFH1-  2' 'CFH2-  2' 'CFH3-  2' 'CFP1-  2' 'CFP2-  2', -
'CFP3-  2'
 LIST FORCES MEMBER  -
 70211 70213
 LOADING LIST   'CASE 1'  'CASE 2'  'W'   'WL'   'LF' 'T' 'DY -   3', -
'DX -   3' 'CFH1-  3' 'CFH2-  3' 'CFH3-  3' 'CFP1-  3' 'CFP2-  3', -
'CFP3-  3'
 LIST FORCES MEMBER  -
 70311 70313 -
 70321 70323
 FINISH
```

EXAMPLE 2

PROBLEM STATEMENT

Generate BAG input coding to analyze the two span structure shown in Figure 3 using the given properties with given origin coordinates and no rotation.

Superstructure Properties

Span length	- span 1	120 ft
	span 2	80 ft
Total length		200 ft
Cross-sectional area		61 ft^2
Moments of inertia		
Torsion (IX)		809 ft^4
Normal Bending (IZ)		510 ft^4
Transverse Bending (IY)		6200 ft^4
Modulus of Elasticity		468000 ksf

Substructure Properties

Bent 2

Top Elevation	210.0 ft
Bottom Elevation	190.0 ft
Number of columns	1

Column

Cross-sectional area	15.0 ft^2
Moments of inertia	
Torsion (IX)	45.0 ft^4
Normal Bending (IZ)	11.2 ft^4
Transverse Bending (IY)	31.2 ft^4
Modulus of Elasticity	468000.0 ksf

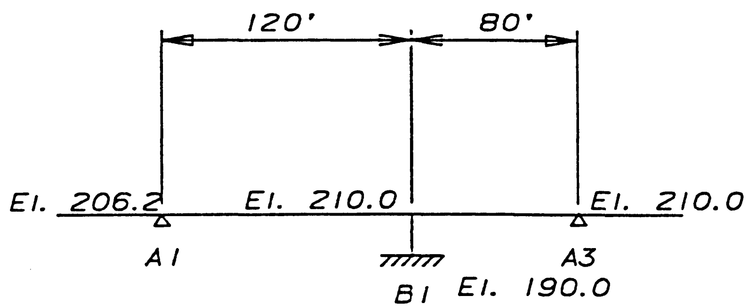
Seismic Loading (CALTRANS)

Peak rock acceleration	0.6 g
Depth to "rock-like" material	0-10 ft

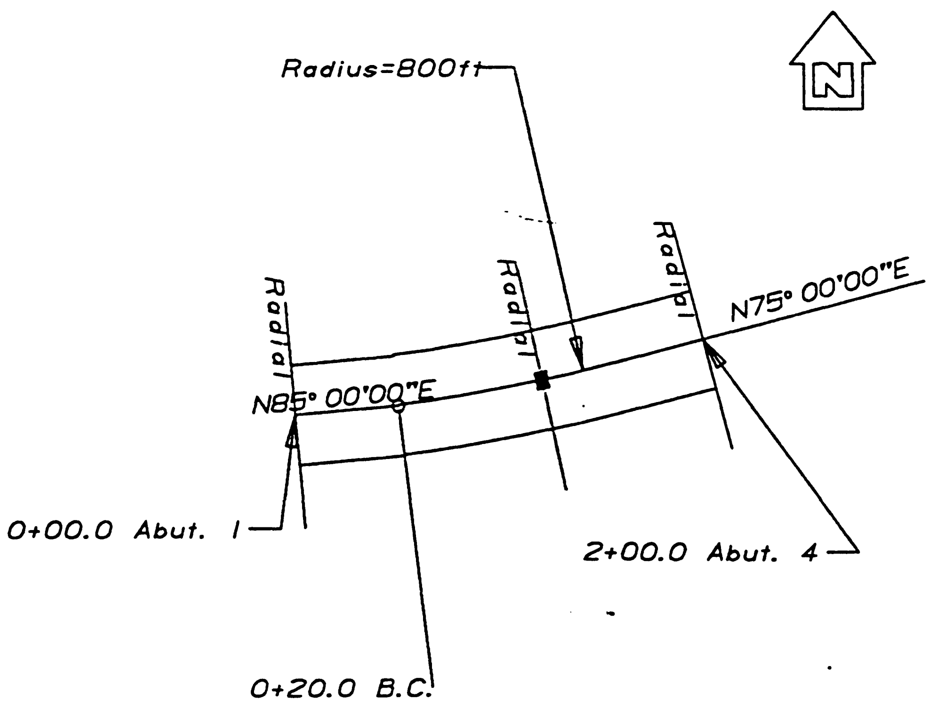
Horizontal Alignment

Curve 1

Tangent Bearings	
BC to PI	N85 00'00"E
PI to EC	N75 00'00"E
Radius	300 ft
Station BC	0+20.00
Station Abutment 1	0+00.00
Elevation Abutment 1	206.20
Elevation Abutment 4	210.00



LINE DIAGRAM-ELEVATION



PLAN

Figure 3

BAG - - EXAMPLE PROBLEM 2

BAG Panel Input

Input Data File

```
|...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8
 1       EXAMPLE 2                                  1    996265  101029110
 2       1N850000EL    800    2000N750000E                               0
 3             0 2062            0     0   2100                 0     0
 4        11200  5100  62000  8090  610 468     0 0     0   0   0   0 550
 4        2 800     0      0     0    0   0     0 0     0   0   0   0   0
 5        1         0   0   0 0 00 0  00 0  0 0 0 0 0 0 0
 5        2         0   0   0 0 00 0  00 0  0 0 0 0 0 0 0
 6        2 2100 1900       1    0    0 0    0 400  3200
 7       0 1   0  150   112   312   450
 8        2000      0       0       0       0       0       0
 9       6A     0       0       0       0       0       0
10        1   0   0   0      0      0
10        2   0   0   0      0      0
11        2     0     0    0    0    0    0    0    0
```

BAG Panel Input Screen 1 - Input

```
*******************************************************************************
*                                                                             *
*                                                                             *
*                                BAG         V 3.01 RELEASE MAY 18, 1988      *
*      RUN DATA                                                               *
*                                                                             *
*       COMMENTS ===>  Example 2______________                                *
*       NOM NJS NJC JMAX NSPX    SF   PLOT ANALYSIS ROTATION REDUCE I/O CONDEN.*
*       ___  _   _  ___  __    _____   _      _       1        _        _     *
*                                                                             *
*      NOM : NO. OF MODES    ( DEFAULT = 12 OR 3 * NO OF SPANS )              *
*      NJS : NO. OF EXTRA JOINTS ADDED PER SPAN ( DEFAULT =  3 )              *
*      NJC : NO. OF EXTRA JOINTS ADDED PER COL. ( DEFAULT =  2 )              *
*      JMAX: MAX. NO. OF JOINTS                 ( DEFAULT = 75 )              *
*      NSPX: MAX. NO. OF SPANS                  ( DEFAULT = 48 )              *
*      PLOT: PLOT LENGTH CODE  ( LENGTH = 18 + 6 * PLOT INCHES, 0 FOR NO PLOT) *
*      ANALYSIS: 0 = STATIC & DYNAMIC , 1 = DYNAMIC ONLY , 2 = STATIC ONLY    *
*      ROTATION: 0 = YES              , 1 = NO                                *
*    ---------------------------------------------------------------------    *
*      EARTHQUAKE LOAD DATA                                                   *
*   PEAK :CURVE:     UP TO 6 ADDITIONAL OPTIONAL DIRECTIONS FOR GIVEN LOAD    *
*   ROCK : DES.:           :          :          :          :         :       *
*   ACC. :      :     2    :    3     :    4     :    5     :    6    :    7  *
*   1/10 G: A-D :          :          :          :          :         :       *
*    6      a  _ _____ _ _ _____ _ _ _____ _ _ _____ _ _ _____ _ _ _____ _    *
*   SPECIAL SITE SPECTRUM  _______   (8 CHARACTERS NAME FOR STRUDL)           *
*                                                                             *
*   F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL *
*                                                                             *
*******************************************************************************
```

BAG Panel Input Screen 1 - Output

```
*******************************************************************************
*                                                                             *
*                                                                             *
*                                BAG         V 3.01 RELEASE MAY 18, 1988      *
*      RUN DATA                                                               *
*                                                                             *
*       COMMENTS ===>  EXAMPLE 2                                              *
*       NOM NJS NJC JMAX NSPX    SF   PLOT ANALYSIS ROTATION                  *
*                                                 1                           *
*                                                                             *
*      NOM : NO. OF MODES    ( DEFAULT = 12 OR 3 * NO OF SPANS )              *
*      NJS : NO. OF EXTRA JOINTS ADDED PER SPAN ( DEFAULT =  3 )              *
*      NJC : NO. OF EXTRA JOINTS ADDED PER COL. ( DEFAULT =  2 )              *
*      JMAX: MAX. NO. OF JOINTS                 ( DEFAULT = 75 )              *
*      NSPX: MAX. NO. OF SPANS                  ( DEFAULT = 48 )              *
*      PLOT: PLOT LENGTH CODE  ( LENGTH = 18 + 6 * PLOT INCHES, 0 FOR NO PLOT) *
*      ANALYSIS: 0 = STATIC & DYNAMIC , 1 = DYNAMIC ONLY , 2 = STATIC ONLY    *
*      ROTATION: 0 = YES              , 1 = NO                                *
*    ---------------------------------------------------------------------    *
*      EARTHQUAKE LOAD DATA                                                   *
*   PEAK :CURVE:     UP TO 6 ADDITIONAL OPTIONAL DIRECTIONS FOR GIVEN LOAD    *
*   ROCK : DES.:           :          :          :          :         :       *
*   ACC. :      :     2    :    3     :    4     :    5     :    6    :    7  *
*   1/10 G: A-D :          :          :          :          :         :       *
*    6      A  _ _____ _ _ _____ _ _ _____ _ _ _____ _ _ _____ _ _ _____ _    *
*   SPECIAL SITE SPECTRUM            (8 CHARACTERS NAME FOR STRUDL)           *
*                                                                             *
*   F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL *
*                                                                             *
*******************************************************************************
```

BAG Panel Input Screen 2 - Input

```
*****************************************************************************************
*                                                                                       *
*                                                                                       *
*                                          BAG                                          *
*      GEOMETRY DATA                                                                    *
*       ORIGIN DATA                               TANGENT OR           ROTATION         *
*              COORDINATES                        BC TO PI              ANGLE           *
*             Z                 X                 BEARING             (DEGREES)         *
*         9962.65___      10102.91__             n 850000 e           __________        *
*       CURVE DATA                                                                      *
*             CURVE     DIR      RADIUS        BC          BEARING                      *
*              NO.      R/L       FT           FT         PI TO EC                      *
*               1        1      800____      20______     n 750000 e                    *
*               2        _      _______      ________     _ ______ _                    *
*                                                                                       *
*    ---------------------------------------------------------------------------        *
*      ABUTMENT DATA                                                                    *
*                                                                                       *
*    ABUTMENT   STATION :ELEVATION:   BEARING  :           RELEASE                      *
*                  FT   :    FT   :            :         FORCE         : MOMENT         *
*                       :         :            :  LONG      TRANS    V :TORSIONAL       *
*      10     0_______   206.24_    _ ______ _   ______    ______   _       _           *
*       0                210____    _ ______ _   ______    ______   _       _           *
*                                                                                       *
*    DESIGN TEMPERATURE RANGE (F) :  35_ DEGREES                                        *
*    (TEMPERATURE COEFFCIENT IS BASED ON CONCRETE.  USER SHOULD CHECK STRUDL CODE.)     *
*                                                                                       *
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL        *
*                                                                                       *
*****************************************************************************************
```

BAG Panel Input Screen 2 - Output

```
*****************************************************************************************
*                                                                                       *
*                                                                                       *
*                                          BAG                                          *
*      GEOMETRY DATA                                                                    *
*       ORIGIN DATA                               TANGENT OR           ROTATION         *
*              COORDINATES                        BC TO PI              ANGLE           *
*             Z                 X                 BEARING             (DEGREES)         *
*            9962.65         10102.91            N 850000 E              0.0000         *
*       CURVE DATA                                                                      *
*             CURVE     DIR      RADIUS        BC          BEARING                      *
*              NO.      R/L       FT           FT         PI TO EC                      *
*               1        L         800          20.0     N 750000 E                     *
*               2        _      _______      ________     _ ______ _                    *
*                                                                                       *
*    ---------------------------------------------------------------------------        *
*      ABUTMENT DATA                                                                    *
*                                                                                       *
*    ABUTMENT   STATION :ELEVATION:   BEARING  :           RELEASE                      *
*                  FT   :    FT   :            :         FORCE         : MOMENT         *
*                       :         :            :  LONG      TRANS    V :TORSIONAL       *
*      10          0.0    206.2     _ ______ _      0         0                         *
*      10                 210.0     _ ______ _      0         0                         *
*                                                                                       *
*    DESIGN TEMPERATURE RANGE (F) :     0 DEGREES                                       *
*    (TEMPERATURE COEFFCIENT IS BASED ON CONCRETE.  USER SHOULD CHECK STRUDL CODE.)     *
*                                                                                       *
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL        *
*                                                                                       *
*****************************************************************************************
```

BAG Panel Input Screen 3 - Input

```
***************************************************************************************
*                                                                                     *
*                                                                                     *
*                                                                                     *
*                                       BAG                                           *
*       SPAN DATA - 1                                                                 *
*                                                                                     *
*     SPAN  LENG :MOMENT OF INERTIA  (FT**4):X-AREA     E   STRUCTURE      MASS       *
*     NO.   (FT) :  IZ         IY       IX    :                 DEPTH      ADDITION    *
*                :NORMAL     TRANS     TOR. :(FT**2)   (KSF)    (FT)       (LB/FT)    *
*      10  120__  510____   6200____  809____  61____  468000_  5.5__     ________    *
*      11  80___  _______   ________  _______  ______  _______  _____     ________    *
*      12  _____  _______   ________  _______  ______  _______  _____     ________    *
*      13  _____  _______   ________  _______  ______  _______  _____     ________    *
*      14  _____  _______   ________  _______  ______  _______  _____     ________    *
*      15  _____  _______   ________  _______  ______  _______  _____     ________    *
*      16  _____  _______   ________  _______  ______  _______  _____     ________    *
*      17  _____  _______   ________  _______  ______  _______  _____     ________    *
*      18  _____  _______   ________  _______  ______  _______  _____     ________    *
*      19  _____  _______   ________  _______  ______  _______  _____     ________    *
*      20  _____  _______   ________  _______  ______  _______  _____     ________    *
*      21  _____  _______   ________  _______  ______  _______  _____     ________    *
*      22  _____  _______   ________  _______  ______  _______  _____     ________    *
*      23  _____  _______   ________  _______  ______  _______  _____     ________    *
*      24  _____  _______   ________  _______  ______  _______  _____     ________    *
*      25  _____  _______   ________  _______  ______  _______  _____     ________    *
*                                                                                     *
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL      *
*                                                                                     *
***************************************************************************************
```

BAG Panel Input Screen 3 - Output

```
***************************************************************************************
*                                                                                     *
*                                                                                     *
*                                                                                     *
*                                       BAG                                           *
*       SPAN DATA - 1                                                                 *
*                                                                                     *
*     SPAN  LENG :MOMENT OF INERTIA  (FT**4):X-AREA     E   STRUCTURE      MASS       *
*     NO.   (FT) :  IZ         IY       IX    :                 DEPTH      ADDITION    *
*                :NORMAL     TRANS     TOR. :(FT**2)   (KSF)    (FT)       (LB/FT)    *
*      10  120.0    510.0    6200.0    809.0    61.0   468000    5.0             0    *
*      11   80.0      0.0       0.0      0.0     0.0        0    0.0             0    *
*      12  _____  _______   ________  _______  ______  _______  _____     ________    *
*      13  _____  _______   ________  _______  ______  _______  _____     ________    *
*      14  _____  _______   ________  _______  ______  _______  _____     ________    *
*      15  _____  _______   ________  _______  ______  _______  _____     ________    *
*      16  _____  _______   ________  _______  ______  _______  _____     ________    *
*      17  _____  _______   ________  _______  ______  _______  _____     ________    *
*      18  _____  _______   ________  _______  ______  _______  _____     ________    *
*      19  _____  _______   ________  _______  ______  _______  _____     ________    *
*      20  _____  _______   ________  _______  ______  _______  _____     ________    *
*      21  _____  _______   ________  _______  ______  _______  _____     ________    *
*      22  _____  _______   ________  _______  ______  _______  _____     ________    *
*      23  _____  _______   ________  _______  ______  _______  _____     ________    *
*      24  _____  _______   ________  _______  ______  _______  _____     ________    *
*      25  _____  _______   ________  _______  ______  _______  _____     ________    *
*                                                                                     *
*    F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL      *
*                                                                                     *
***************************************************************************************
```

BAG Panel Input Screen 6 - Input

```
**********************************************************************************
*                                                                                *
*                                                                                *
*                                                                                *
*                                    BAG                                         *
*      BENT DATA - 1                                                             *
*                                                                                *
*   BENT:   ELEVATION  :           :NO.  C-C      E    : COL. :  ------ CAP -------  *
*      : TOP    BOTTOM :  BEARING :OF    COL           :      :   IZ      AREA   LENG  *
*    NO.: (FT)    (FT) :          :COL.  (FT)    (KSF) : TYPE :(FT**4) (FT**2)  (FT)  *
*     2  210     190                1                                  40.0   32.0  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*                                                                                *
*   F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL   *
*                                                                                *
**********************************************************************************
```

BAG Panel Input Screen 6 - Output

```
**********************************************************************************
*                                                                                *
*                                                                                *
*                                                                                *
*                                    BAG                                         *
*      BENT DATA - 1                                                             *
*                                                                                *
*   BENT:   ELEVATION  :           :NO.  C-C      E    : COL. :  ------ CAP -------  *
*      : TOP    BOTTOM :  BEARING :OF    COL           :      :   IZ      AREA   LENG  *
*    NO.: (FT)    (FT) :          :COL.  (FT)    (KSF) : TYPE :(FT**4) (FT**2)  (FT)  *
*     2  210.0   190.0  _ ______ _   1   0.0        0     0       0.0   40.0   32.0  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*    __ ______ ______ _ ______ _ __  ____  ______    _    ______  _____  _____  *
*                                                                                *
*   F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL   *
*                                                                                *
**********************************************************************************
```

BAG Panel Input Screen 9 - Input

```
*************************************************************************************
*                                                                                   *
*                                                                                   *
*                                                                                   *
*                                   BAG                                             *
*      COLUMN DATA                                                                  *
*                                                                                   *
*       STORE :                   SEGMENT                                           *
*       COLUMN:      LENGTH  AREA   :   MOMENT OF INERTIA (FT**4)                   *
*        TYPE : NO.   (FT)  (FT**2) :IZ(LONGIT)  IY(TRANS)  IX(TOR)                 *
*         _     1_   _____  15____     11.2___    31.2___   45_____                 *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*                                                                                   *
*   F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL     *
*                                                                                   *
*************************************************************************************
```

BAG Panel Input Screen 9 - Output

```
*************************************************************************************
*                                                                                   *
*                                                                                   *
*                                                                                   *
*                                   BAG                                             *
*      COLUMN DATA                                                                  *
*                                                                                   *
*       STORE :                   SEGMENT                                           *
*       COLUMN:      LENGTH  AREA   :   MOMENT OF INERTIA (FT**4)                   *
*        TYPE : NO.   (FT)  (FT**2) :IZ(LONGIT)  IY(TRANS)  IX(TOR)                 *
*         0     1      0.0    15.0        11.2       31.2      45.0                 *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*         _     __   _____  ______    _______    _______   _______                  *
*                                                                                   *
*   F1/RUN F2/GEOM F3/QUIT F4/SPAN F5/BENT F6/PSAVE F7/PB F8/PF F9/FILE F10/COL     *
*                                                                                   *
*************************************************************************************
```

BAG Output

```
 STRUDL '        ' 'EXAMPLE 2                '
 DEBUG ALL & SCAN CONDITIONAL
 REORG 5
$                       BBBBBBB      A       GGGGGG
$                       BBBBBBBB    AAA     GGGGGGGG
$                       BB    BB   AA AA    GG    GG
$                       BB    BB  AA   AA   GG
$                       BB    BB  AA   AA   GG
$                       BBBBBBB   AAAAAAA   GG
$                       BB    BB  AAAAAAA   GG  GGGGGG
$                       BB    BB  AA   AA   GG  GGGGGG
$                       BB    BB  AA   AA   GG    GG
$                       BBBBBBBB  AA   AA   GGGGGGGG
$                       BBBBBBB   AA   AA   GGGGGG
$ ****************************************************************
$ THE STRUDL CODING FOR THIS ANALYSIS WAS COMPUTER GENERATED USING
$ BAG(PRODUCTION) MOD 21  6.27.90
$ THE FOLLOWING INPUT AND GENERATED STRUDL CODING
$ SHOULD BE VERIFIED TO BE SURE THE GENERATED MODEL IS VALID
$
$ ****************  G E O M E T R Y   D A T A  *******************
$
$ CURVE DIR
$ 0=R  1=L   RADIUS   BC STA    TAN AZIMUTH
$                                 84.9999
$   1          800.     20.00     74.9999
$
$ *****************  A B U T M E N T    D A T A  *****************
$
$                                ******** RELEASES ************
$ ABUT   STA     ELEV   AZIMUTH  LONG F  TRANS F  VERT F  TORSION
$  10       0.0  206.2  354.9998    0       1      1        1
$  12            210.0  344.9998    0       1      1        1
$
$ *****************  S P A N    D A T A  *************
$
$   SPAN       IZ      IY       IX      AX    MODULUS  STRUCTURE DEPTH
$ 10 120.0   510.0  6200.0   809.0   61.0      468000.    5.50
$ 11  80.0   510.0  6200.0   809.0   61.0      468000.    5.50
$
$ *********S T A T I C   L O A D   D A T A  ********
$
$     SPAN      W         WL        LF     UMASS     TEMP
$      10     1.000     0.100     1.000      0.       35.
$      11     1.000     0.100     1.000      0.
$
$ ****************   B E N T    D A T A  *************************
$
$      ELEVATIONS           NO  C-C  COL          CAP DATA
$ BT   TOP   FTG    AZIMUTH COL COL MODULUS COL   IZ      AX     CAP LT.
$ 11  210.0  190.0  347.8379 1  0.0  468000.  0    0.0    40.0    32.0
$
$ ****************   B E N T    R E L E A S E S   ****************
$
$   BENT                    FORCE RELEASES
$           MOM REL TOP         FOR REL FTG        MOM REL FTG
$    11       1 1 1        1        1        1        1        1        1
$
$ ************ CENTRIFUGAL    FORCE    DATA  *****   COL  WIND   FORCE  *****
$
$ BT   CFH1   CFH2   CFH3   CFP1   CFP2   CFP3       CWFL        CWFT
$ 11    0.     0.     0.     0.     0.     0.       1.000       1.000
$
$ ****************   C O L U M N    D A T A  ***************************
```

```
$
$ TYPE  SEG    L    AREA      IZ      IY      IX
$  0     1    0.0   15.0     11.2    31.2    45.0
$
$ ****************  R U N     D A T A  ********************************
$
$      EXTRA JOINTS
$       SPAN   COL   MAX SPANS  TOTAL JOINTS  MAX JOINTS  SPEC MOD F  PLOT COND
$        3      2       50           14           75        1.0000      0  1
$
$ THE STRUCTURE HAS BEEN ROTATED     0.0000 DEGREES (CLOCKWISE = + )
$ FROM THE INPUT LOCATION TO PERMIT SEISMIC LOADS TO BE APPLIED
$ IN THE GLOBAL X AND Z DIRECTIONS
$
$ ***********************************************************************
 TYPE SPACE FRAME
 UNITS FEET KIPS DEGREES LBM
$
$                JOINT NUMBER KEY
$      JOINT      DIGIT 1  DIGITS 2,3  DIGIT 4   DIGIT 5
$  ============= ======= =========== ========= =========
$  SUPERSTRUCTURE    1      SPAN NO.  JOINT NO.   -----
$      HINGE         2      SPAN NO.  JOINT NO.   -----
$    ABUTMENT        3    SUPPORT NO. JOINT NO.   -----
$     COLUMN         4      BENT NO.   COL. NO.  JOINT NO.
$
 JOINT COORDINATES
$   JOINT       X         Y         Z
$      SUPERSTRUCTURE
$
$ ADDITIONAL COORDINATES TO BE USED FOR THE PHASE2 RETROFIT - TENSION MODEL ONLY
$ COORDINATES MUST BE PROVIDED BY THE ENGINEER
$
$    3091      0.00      0.00      0.00    SUPPORT   $  TENSION MODEL ONLY
$    3131      0.00      0.00      0.00    SUPPORT   $  TENSION MODEL ONLY
     3101  10102.91    206.20   9962.65    SUPPORT
     1102  10103.91    206.23   9962.56
     1103  10133.53    207.15   9959.89
     1104  10163.07    208.10   9956.35
     1105  10192.45    209.05   9951.71
     1111  10221.64    210.00   9945.99
     1112  10240.90    210.00   9941.59
     1113  10260.04    210.00   9936.72
     1114  10279.11    210.00   9931.60
     1115  10298.19    210.00   9926.49
     3121  10299.15    210.00   9926.23    SUPPORT
$     COLUMN/S
    41111  10221.64    190.00   9945.99    SUPPORT
    41112  10221.64    196.67   9945.99
    41113  10221.64    203.33   9945.99
$
$           MEMBER NUMBER KEY
$     MEMBER      DIGIT 1  DIGITS 2,3  DIGIT 4   DIGIT 5
$ ============== ======= ========== ========= =========
$ SUPERSTRUCTURE     5      SPAN NO.   MEM. NO.   -----
$      CAP           6      BENT NO.   MEM. NO.   -----
$    COLUMN          7      BENT NO.   COL. NO.  MEM. NO.
$   RESTRAINER       8      SPAN NO.   -------    -----
$
 MEMBER INCIDENCES
$ MEMBER   START    END
$      SUPERSTRUCTURE
 MEMBER INCIDENCES
    5101     3101    1102
    5102     1102    1103
    5103     1103    1104
    5104     1104    1105
    5105     1105    1111
    5111     1111    1112
```

```
     5112    1112    1113
     5113    1113    1114
     5114    1114    1115
     5115    1115    3121
  TYPE SPACE TRUSS
  MEMBER INCIDENCES
 $
 $ ADD RESTRAINERS AT ABUTMENTS FOR USE IN THE PHASE2 RETROFIT-TENSION MODEL ONLY
 $
 $    809    3091    1103     $  TENSION MODEL ONLY
 $    811    1114    3131     $  TENSION MODEL ONLY
  TYPE SPACE FRAME
  MEMBER INCIDENCES
 $     COLUMN/S
    71111   41111   41112
    71112   41112   41113
    71113   41113    1111
 $
 $ SUPERSTRUCTURE MEMBERS
 $
  GROUP     '/GP/SUPE'    DEFINITION
  MEMB 5101 THRU   5105
  MEMB 5111 THRU   5115
  END    GROUP DEFINITION
 $  SUPERSTRUCTURE MEMBER PROPERTIES
  MEMBER PROPERTIES PRISMATIC
  5101 THRU 5105 AX   61.0 IX      809.0 IY     6200.0 IZ      510.0
  5111 THRU 5115 AX   61.0 IX      809.0 IY     6200.0 IZ      510.0
 $
 $ COLUMN MEMBERS
 $
  GROUP  '/GP/COLS'    DEFINITION
  MEMB      71111      THRU      71113
  END    GROUP DEFINITION
 $ COLUMN MEMBER PROPERTIES
  MEMB PROP PRIS AX   15.0 IX       45.0 IY       31.2 IZ       11.2
  71111
  MEMB PROP PRIS AX   15.0 IX       45.0 IY       31.2 IZ       11.2
  71112
  MEMB PROP PRIS AX   15.0 IX       45.0 IY       31.2 IZ       11.2
  71113
 $
 $ CAP MEMBERS
 $
  GROUP  '/GP/CAPS'    DEFINITION
  END  GROUP DEFINITION
 $ CAP MEMBER PROPERTIES
  MEMBER PROPERTIES PRISMATIC
 $ RESTRAINER MEMBER PROPERTIES
 $
 $ AREA OF ADDED RESTRAINERS FOR THE PHASE2 RETROFIT AT THE  ABUTMENTS FOR THE
 $    TENSION ONLY MODEL
 $
  MEMBER PROPERTIES PRISMATIC
 $       809   AX      0.     $  TENSION ONLY MODEL ADD RESTRAINER AREA
 $       811   AX      0.     $  TENSION ONLY MODEL ADD RESTRAINER AREA
 $
  CONSTANTS
  DENSITY 150.0 ALL
  G 172800. ALL
  CTE 0.0000065 ALL
 $ SUPERSTRUCTURE MODULUS OF ELASTICITY
  E   468000.  5101 THRU  5105
  E   468000.  5111 THRU  5115
 $ COLUMN/S MODULUS OF ELASTICITY
  E   468000. 71111 THRU 71113
 $ RESTRAINER MODULUS OF ELASTICITY
 $
 $ MODULUS OF ELASTICITY FOR THE ADDED RESTRAINERS FOR THE PHASE2 RETROFIT AT THE
```

```
$  ABUTMENTS FOR THE TENSION ONLY MODEL
$
$
$ E  1440000.    809     $  TENSION ONLY MODEL
$ E  1440000.    811     $  TENSION ONLY MODEL
$ BETA ANGLES FOR COLUMNS
 BETA   12.1621 71111 THRU 71113
$  ABUTMENT  10  RELEASES
$
$ MEMBER RELEASE REQUIRED FOR THE TENSION ONLY MODEL
$
 MEMBER 5101 REL END FOR X
  JOINT 3101 RELEASE           MOM    Y  Z  -
  TH2    -5.0002
$  ABUTMENT  12  RELEASES
$
$ MEMBER RELEASE REQUIRED FOR THE TENSION ONLY MODEL
$
 MEMBER 5115 REL STA FOR X
  JOINT 3121 RELEASE           MOM    Y  Z  -
  TH2   -15.0002
$   COLUMN RELEASES
$ COLUMN MEMBER END JOINT SIZE
 MEMBER END JOINT SIZE
  MEMBER   71113  END SIZE END       2.75
$
$ REMOVE MEMBER RELEASES FORCE X AT ABUTMENTS AND HINGES FOR THE COMPRESSION
$ MODEL
$
$ INACTIVATE RESTRAINERS AT HINGES AND ABUTMENTS WHEN USING THE
$      COMPRESSION ONLYMODEL
$
$ INACTIVE JOINT  3091  3131     $  COMPRESSION ONLY MODEL
$ INACTIVE MEMBERS   809     $  COMPRESSION ONLY MODEL
$ INACTIVE MEMBERS   811     $  COMPRESSION ONLY MODEL
 INERTIA OF JOINTS LUMPED
$ HINGE WEIGHT
 INERTIA OF JOINTS ADD
$ CAP WEIGHT
 INERTIA OF JOINTS ADD
      1111    LINEAR ALL          192000.00
 DAMPING PERCENTS  5.0   12
 SHOCK SPECTRUM LOAD ' Z DIR' 'EXAMPLE 2                 '
 SPECTRUM TRANSLATION Z  1.000 X  0.000 FILE 'S.6GA51' FACTOR 1.0000
 END OF DYNAMIC LOAD
 SHOCK SPECTRUM LOAD ' X DIR' 'EXAMPLE 2                 '
 SPECTRUM TRANSLATION Z  0.000 X  1.000 FILE 'S.6GA51' FACTOR 1.0000
 END OF DYNAMIC LOAD
 LOAD ' TRANS'
 CQC LOAD ' Z DIR'
 LOAD 'LONGIT'
 CQC LOAD ' X DIR'
 LOAD COMB 'CASE 1' 'TRANS PLUS 0.3 TIMES LONGIT       CQC'
 LOAD COMB 'CASE 2' 'LONGIT PLUS 0.3 TIMES TRANS       CQC'
 PRINT STRUCTURAL DATA
 DEFINE INERTIA WEIGHT LOAD 'D' WITH FACTORS  LINEAR Y  -1.
  LOADING LIST  'D'
 STIFFNESS ANALYSIS REDUCE BAND
  OUTPUT DECIMAL  5
 LIST DISPLACEMENTS ALL
 STATISTICS PARAMETERS
 INERTIA MATRIX LUMPED
 KINEMATIC CONDENSATION INDEPENDENT     36
 MODAL ANALYSIS     12
 STATISTICS ANALYSIS REDUCE BAND
 END STATISTICS
 ASSEMBLE FOR DYNAMICS REDUCE BAND
 INDEPENDENT DEGREE OF FREEDOM SELECT
 CONDENSE DYNAMIC MATRICES
```

```
 DUMP ORTHOGONALITY
 MODAL ANALYSIS HOW  12
 LIST DYNAMIC NORMALIZED EIGENVECTORS
 LIST DYNAMIC PARTICIPATION FACTORS
$  LIST DYNAMIC NORMALIZED EIGENVECTORS BY JOINT -
$   3101 1102 1111 1115 3121
 SHOCK SPECTRUM ANALYSIS LOAD  ' Z DIR'   ' X DIR'
 GENERATE RESULTS FOR LOADS ' TRANS' 'LONGIT'  ' TRANSC' 'LONGITC'
 COMBINE 'CASE 1' ' TRANS' 1.0 'LONGIT' 0.3
 COMBINE 'CASE 2' 'LONGIT' 1.0 ' TRANS' 0.3
 COMBINE 'CASE 3' ' TRANSC' 1.0 'LONGITC' 0.3
 COMBINE 'CASE 4' 'LONGITC' 1.0 ' TRANSC' 0.3
 LOAD LIST 'CASE 1' 'CASE 2' 'CASE 3' 'CASE 4'
 OUTPUT DECIMAL 1
$ LIST ELASTIC COL MEM FORCES (A*R*S LOAD)
 LIST FORCES MEMBERS -
 71111 71113
$
$ LIST FORCES DIST MEMS -
$ 809      $  TENSION ONLY MODEL
$ 811      $  TENSION ONLY MODEL
$ LIST ELAS. GLOBAL DISP FOR MAJOR JOINTS (A*R*S LOAD)
 OUTPUT DECIMAL 4
 LIST DISPLACEMENTS JOINTS -
 3101 1102 1111 1115 3121
 OUTPUT DECIMAL 1
$ LIST ELAS MEM FORCES AT ABUTS AND HINGES (A*R*S LOAD)
 LIST FORCES MEMBERS -
 5101 5115
 FINISH
 LOAD LIST   ' Z DIR'   ' X DIR'
 OUTPUT DECIMAL 4
 LIST DYNAMIC MODAL SHOCK SPECT FORCES MEMS -
 71111 71113
 LIST DYNAMIC MODAL SHOCK SPECT DISP JOINTS -
 3101 1102 1111 1115 3121
$
$ LIST DYNAMIC MODAL SHOCK SPECT FORCES DIST MEMS -
$ 809      $  TENSION ONLY MODEL
$ 811      $  TENSION ONLY MODEL
$ LIST MODAL MEM FORCES AT ABUTS AND HINGES
 LIST DYNAMIC MODAL SHOCK SPECT FORCES MEMS -
 5101 5115
 FINISH
  CHANGES
  ADDITIONS
 PRINT JOINT RELEASES
$ BRIDGES WITH SHARP RADIUS CURVES(CURVES LESS THAN OR EQUAL
$ TO 1000.0 FEET) MAY GIVE A STATIC CHECK UNBALANCE MESSAGE.
$ IGNORE THIS MESAGE AS THE RESULTS OF THE STATICS RUN ARE
$ SATISFACTORY.
$
$
$ NOTE: DEAD LOAD IS TO BE USED FOR SINGLE COLUMN BENTS ONLY!
$
 DELETION
  LOADING 'D'
 ADDITION
DEFINE INERTIA WEIGHT LOAD 'D' WITH FACTORS  LINEAR Y  -1.
 LOADING   'W'     'WIND LOAD ON STRUCTURE'
 MEMBER LOADS
          5101  THRU   5105  FORCE  Z  GLOBAL PROJ UNI  W     1.000
          5111  THRU   5115  FORCE  Z  GLOBAL PROJ UNI  W     1.000
          5101  THRU   5105  FORCE  X              UNI  W     0.240
          5111  THRU   5115  FORCE  X              UNI  W     0.240
         71111  THRU  71113  FORCE  Z  GLOBAL PROJ UNI  W     1.000
         71111  THRU  71113  FORCE  X  GLOBAL PROJ UNI  W     1.000
 LOADING   'WL'     'WIND LOAD ON LIVE LOAD'
 MEMBER LOADS
```

```
          5101  THRU  5105  FORCE  Z  GLOBAL PROJ UNI  W    0.100
          5101  THRU  5105  MOM    X  GLOBAL PROJ UNI  W    0.875
          5111  THRU  5115  FORCE  Z  GLOBAL PROJ UNI  W    0.100
          5111  THRU  5115  MOM    X  GLOBAL PROJ UNI  W    0.875
          5101  THRU  5105  FORCE  X              UNI  W    0.040
          5101  THRU  5105  MOM    Z              UNI  W    0.350
          5111  THRU  5115  FORCE  X              UNI  W    0.040
          5111  THRU  5115  MOM    Z              UNI  W    0.350
 LOADING  'LF'    'LONGITUDINAL FORCE    '
 MEMBER LOADS
          5101  THRU  5105  FORCE  X              UNI  W    1.000
          5101  THRU  5105  MOM    Z              UNI  W    8.750
          5111  THRU  5115  FORCE  X              UNI  W    1.000
          5111  THRU  5115  MOM    Z              UNI  W    8.750

$
  LOADING   'T'     'TEMPERATURE LOAD'
  MEMBER TEMPERATURE LOADS
  '/GP/SUPE'  AXIAL    35.
  '/GP/COLS'  AXIAL    35.
$
$ FOR BENT  11
$
$
  LOADING  'DY -  11'   'TRANS MOMENT DISTRIBUTION'
$ FOR SINGLE COLUMN BENTS USE THE FOLLOWING COMMAND (ADD + 1 OR - 1 TO
$ THE ANSWER)
  MEMBER    71113  END LOAD END   MOMENT Y 1.0
$
  LOADING  'DX -  11'  'LONGIT MOMENT DISTRIBUTION'
$ FOR SINGLE COLUMN BENTS USE THE FOLLOWING COMMAND (ADD + 1 OR - 1 TO
$ THE ANSWER)
  MEMBER    71113  END LOAD END   MOMENT Z 1.0
 STIFFNESS ANALYSIS REDUCE BAND
$  THE COMMAND ABOVE LISTS ALL RESULTS
  OUTPUT DECIMAL      2
$  THE FOLLOWING COMMANDS REFORMAT THE COLUMN FORCES ONLY
  OUTPUT BY MEMBER
$ LIST COLUMN MEMBER FORCES
 LOADING LIST 'CASE 1' 'CASE 2' 'D' 'W' 'WL' 'LF' 'T' 'DY -  11', -
'DX -  11' 'CFH1- 11' 'CFH2- 11' 'CFH3- 11' 'CFP1- 11' 'CFP2- 11', -
'CFP3- 11'
 LIST FORCES MEMBER  -
 71111 71113
 FINISH
```

EXAMPLE 3

PROBLEM STATEMENT

Basically, there are two methods to model the 'Y' or forked shape structures.

The first mothod is to model the main portion of the structure in BAG and let it rotate. Then you need to calculate the new origin coordinates for the rest of the model so that you can use it for the second and later BAG model. Describe the remaining portion of structure with the new origin and give the rotation angle from the main portion. After all models are generate, merge them all together.

The second mothod is to model the structure without rotation. In this case, no modification of the origin is needed. After all models are generated, merge them all together. Now you need to modify the earthquake force direction to the primary direction of the structure.

The first method is available only through the BAG program whereas the second method can be done from either STRUBAG or BAG. Before the BAG program is available, people often merge models through a different approach and we are going to show this in Example 3. Actually, Example 1 and Example 2 are one 'Y' shape structure. We have generated the main portion of the structure in Example 1, then we calculate the new origin coordiantes and new bearing for the remained structure. With all new data, we generate the Example 2 without rotation. From the example 1 and example 2, now we can combine this two STRUDL model together. The example 2 bridge is going to tie into example bridge at the hinge and a new member has to be added into the final coding.

Note: It is necessary to add members to connect different models. A common pracetice for these members is to make the end joint size very big so that these members act like rigid body. Whenever the end joint size is used the actual member length shuld be longer than 0.01 feet. Otherwise will cause a STRUDL error.

STRUDL FILE AFTER MERGE

```
 STRUDL '         ' 'EXAMPLE PROBLEM  1 & 2  '
 DEBUG ALL & SCAN CONDITIONAL
 REORG 5
$                       BBBBBBB      A       GGGGGG
$                       BBBBBBBB    AAA     GGGGGGGG
$                       BB    BB   AA AA    GG    GG
$                       BB    BB  AA   AA   GG
$                       BB    BB  AA   AA   GG
$                       BBBBBBB   AAAAAAA   GG
$                       BB    BB  AAAAAAA   GG  GGGGGG
$                       BB    BB  AA   AA   GG  GGGGGG
$                       BB    BB  AA   AA   GG    GG
$                       BBBBBBBB  AA   AA   GGGGGGGG
$                       BBBBBBB   AA   AA   GGGGGG
$ ******************************************************************
$ THE STRUDL CODING FOR THIS ANALYSIS WAS COMPUTER GENERATED USING
$ BAG(PRODUCTION) MOD 21  6.27.90
$ THE FOLLOWING INPUT AND GENERATED STRUDL CODING
$ SHOULD BE VERIFIED TO BE SURE THE GENERATED MODEL IS VALID
$
$ ****************  G E O M E T R Y   D A T A  ********************
$
$ CURVE DIR
$ 0=R  1=L   RADIUS   BC STA    TAN AZIMUTH
$                                 61.9764
$   0          300.   1025.10     96.8083
$   1          300.   1275.30     57.9736
$
$ *****************  A B U T M E N T   D A T A  *****************
$
$                               ******** RELEASES ************
$ ABUT   STA     ELEV   AZIMUTH  LONG F  TRANS F  VERT F  TORSION
$   1    1105.1  210.1  347.2551     0        0      1        1
$   4            200.1   12.9779   300      100      1        1
$
$ *****************  S P A N    D A T A  **************
$
$   SPAN       IZ      IY       IX      AX     MODULUS  STRUCTURE DEPTH
$  1  80.0   510.0  6200.0   809.0   61.0      468000.     5.00
$  2 100.0   510.0  6200.0   809.0   61.0      468000.     5.00
$  3  80.0   462.4 60951.2  1461.7  122.9      468000.     5.00
$
$ *********S T A T I C   L O A D   D A T A  ********
$
$     SPAN      W         WL        LF      UMASS     TEMP
$       1     1.000     0.100     1.000       0.       35.
$       2     1.000     0.100     1.000       0.
$       3     1.000     0.100     1.000       0.
$
$ *****************  H I N G E    D A T A  **********************
$
$              **** RESTRAINER DATA ********** HINGE   DATA  ********
$ SPAN HINGE   LENGTH   AREA  MODULUS          AREA   LENGTH
$   2   20.0    20.0     3.1  1440000.00        40.0      24.00
$
$ ****************  B E N T    D A T A  *************************
$
$      ELEVATIONS            NO  C-C  COL          CAP DATA
$ BT    TOP   FTG     AZIMUTH COL COL MODULUS COL    IZ        AX      CAP LT.
$  2  207.0  183.0     2.5339 1  0.0  468000.  1  700.0     40.0    32.0
$  3  203.2  148.5   328.9114 2 24.0  468000.  2  700.0     40.0    32.0
$
$ ****************  B E N T    R E L E A S E S  *****************
$
```

```
$   BENT                    FORCE RELEASES
$           MOM REL TOP          FOR REL FTG        MOM REL FTG
$     2      1 1 1        1        1        1        1        1        1
$     3      1 1 1        1        1        1        1        1        1
$
$ *********** CENTRIFUGAL    FORCE    DATA  *****   COL  WIND   FORCE  *****
$
$ BT   CFH1   CFH2   CFH3   CFP1   CFP2   CFP3       CWFL        CWFT
$  2     0.     0.     0.     0.     0.     0.       1.000       1.000
$  3     0.     0.     0.     0.     0.     0.       1.000       1.000
$
$ ***************   C O L U M N    D A T A  ***************************
$
$ TYPE  SEG    L    AREA       IZ       IY      IX
$  1      1   0.0   15.0     11.2     31.2    45.0
$  2      1   0.0   12.0      9.0     16.0    36.0
$
$ ****************  R U N      D A T A  ********************************
$
$      EXTRA JOINTS
$       SPAN    COL   MAX SPANS  TOTAL JOINTS  MAX JOINTS  SPEC MOD F  PLOT COND
$         3      2       48          28            75       1.0000       1  1
$
$ THE STRUCTURE HAS BEEN ROTATED   -21.5180 DEGREES (CLOCKWISE = + )
$ FROM THE INPUT LOCATION TO PERMIT SEISMIC LOADS TO BE APPLIED
$ IN THE GLOBAL X AND Z DIRECTIONS
$
$ *********************************************************************
 TYPE SPACE FRAME
 UNITS FEET KIPS DEGREES LBM
$
$                JOINT NUMBER KEY
$      JOINT      DIGIT 1  DIGITS 2,3  DIGIT 4   DIGIT 5
$  ============= ======= =========== ========= =========
$  SUPERSTRUCTURE    1      SPAN NO.  JOINT NO.   -----
$      HINGE         2      SPAN NO.  JOINT NO.   -----
$    ABUTMENT        3    SUPPORT NO. JOINT NO.   -----
$     COLUMN         4      BENT NO.   COL. NO.  JOINT NO.
$
 JOINT COORDINATES
$   JOINT        X          Y          Z
$      SUPERSTRUCTURE
    3011  10000.00    210.10  10000.00    SUPPORT
    1012  10000.97    210.06   9999.78
    1013  10020.37    209.32   9996.12
    1014  10039.98    208.55   9993.75
    1015  10059.70    207.77   9992.68
    1021  10079.44    207.00   9992.90
    2022  10099.38    206.24   9994.45
    2023  10100.37    206.20   9994.56
    1024  10119.98    205.46   9996.89
    1025  10139.60    204.72   9999.23
    1026  10159.21    203.98  10001.58
    1031  10178.83    203.24  10003.76
    1032  10198.55    202.43  10004.81
    1033  10218.29    201.67  10004.56
    1034  10237.98    200.90  10003.02
    1035  10257.52    200.14  10000.17
    3041  10258.50    200.10  10000.00    SUPPORT
$     COLUMN/S
   40211  10079.44    183.00   9992.90    SUPPORT
   40212  10079.44    191.00   9992.90
   40213  10079.44    199.00   9992.90
   40311  10172.63    148.50   9993.48    SUPPORT
   40312  10172.63    166.73   9993.48
   40313  10172.63    184.97   9993.48
   40314  10172.63    203.20   9993.48
   40321  10185.02    148.50  10014.03    SUPPORT
   40322  10185.02    166.73  10014.03
```

```
      40323  10185.02    184.97  10014.03
      40324  10185.02    203.20  10014.03
$   |----------------------------------------|
$   |         EXAMPLE 2                      |
$   V                                        V
$         SUPERSTRUCTURE
        3101  10102.91    206.20    9962.65                 $ <-- MODIFYIED
        1102  10103.91    206.23    9962.56
        1103  10133.53    207.15    9959.89
        1104  10163.07    208.10    9956.35
        1105  10192.45    209.05    9951.71
        1111  10221.64    210.00    9945.99
        1112  10240.90    210.00    9941.59
        1113  10260.04    210.00    9936.72
        1114  10279.11    210.00    9931.60
        1115  10298.19    210.00    9926.49
        3121  10299.15    210.00    9926.23    SUPPORT
$       COLUMN/S
      41111  10221.64    190.00    9945.99    SUPPORT
      41112  10221.64    196.67    9945.99
      41113  10221.64    203.33    9945.99
$   A                                        A
$   |         EXAMPLE 2                      |
$   |----------------------------------------|
$
$              MEMBER NUMBER KEY
$       MEMBER      DIGIT 1  DIGITS 2,3  DIGIT 4   DIGIT 5
$ ============== ======= =========== ========= =========
$ SUPERSTRUCTURE     5      SPAN NO.   MEM. NO.   -----
$      CAP           6      BENT NO.   MEM. NO.   -----
$    COLUMN          7      BENT NO.   COL. NO.  MEM. NO.
$   RESTRAINER       8      SPAN NO.   -------    -----
$
 MEMBER INCIDENCES
$ MEMBER    START    END
$        SUPERSTRUCTURE
     5011     3011     1012
     5012     1012     1013
     5013     1013     1014
     5014     1014     1015
     5015     1015     1021
     5021     1021     2022
     5022     2022     2023
     5023     2023     1024
     5024     1024     1025
     5025     1025     1026
     5026     1026     1031
     5031     1031     1032
     5032     1032     1033
     5033     1033     1034
     5034     1034     1035
     5035     1035     3041
 TYPE SPACE TRUSS
$     RESTRAINER/S
 MEMBER INCIDENCES
      802     1021     1024
 TYPE SPACE FRAME
 MEMBER INCIDENCES
$      COLUMN/S
    70211    40211    40212
    70212    40212    40213
    70213    40213     1021
    70311    40311    40312
    70321    40321    40322
    70312    40312    40313
    70322    40322    40323
    70313    40313    40314
    70323    40323    40324
$       CAP/S
```

```
    6031   40314    1031
    6032    1031   40324
$       HINGE/S
    6101    2022    3101              $  <----------- ADD
$  |-------------------------------------------|
$  |           EXAMPLE 2                       |
$  V                                           V
$       SUPERSTRUCTURE
    5101    3101    1102
    5102    1102    1103
    5103    1103    1104
    5104    1104    1105
    5105    1105    1111
    5111    1111    1112
    5112    1112    1113
    5113    1113    1114
    5114    1114    1115
    5115    1115    3121
$      COLUMN/S
   71111   41111   41112
   71112   41112   41113
   71113   41113    1111
$  A                                           A
$  |           EXAMPLE 2                       |
$  |-------------------------------------------|
$
$ SUPERSTRUCTURE MEMBERS
$
 GROUP     '/GP/SUPE'    DEFINITION
 MEMB 5011 THRU   5015
 MEMB 5021 THRU   5026
 MEMB 5031 THRU   5035
$  |-------------------------------------------|
$  |           EXAMPLE 2                       |
$  V                                           V
 MEMB 5101 THRU   5105
 MEMB 5111 THRU   5115
$  A                                           A
$  |           EXAMPLE 2                       |
$  |-------------------------------------------|
 END    GROUP DEFINITION
$  SUPERSTRUCTURE MEMBER PROPERTIES
 MEMBER PROPERTIES PRISMATIC
 5011 THRU 5015 AX   61.0 IX      809.0 IY     6200.0 IZ      510.0
 5021 THRU 5026 AX   61.0 IX      809.0 IY     6200.0 IZ      510.0
 5031 THRU 5035 AX  122.9 IX     1461.7 IY    60951.2 IZ      462.4
$  |-------------------------------------------|
$  |           EXAMPLE 2                       |
$  V                                           V
 5101 THRU 5105 AX   61.0 IX      809.0 IY     6200.0 IZ      510.0
 5111 THRU 5115 AX   61.0 IX      809.0 IY     6200.0 IZ      510.0
$  A                                           A
$  |           EXAMPLE 2                       |
$  |-------------------------------------------|
$
$ COLUMN MEMBERS
$
 GROUP  '/GP/COLS'    DEFINITION
 MEMB      70211      THRU      70213
 MEMB      70311      THRU      70313
 MEMB      70321      THRU      70323
$  |-------------------------------------------|
$  |           EXAMPLE 2                       |
$  V                                           V
 MEMB      71111      THRU      71113
$  A                                           A
$  |           EXAMPLE 2                       |
$  |-------------------------------------------|
```

```
 END    GROUP DEFINITION
$ COLUMN MEMBER PROPERTIES
 MEMB PROP PRIS AX   15.0 IX      45.0 IY      31.2 IZ      11.2
 70211
 MEMB PROP PRIS AX   15.0 IX      45.0 IY      31.2 IZ      11.2
 70212
 MEMB PROP PRIS AX   15.0 IX      45.0 IY      31.2 IZ      11.2
 70213
 MEMB PROP PRIS AX   12.0 IX      36.0 IY      16.0 IZ       9.0
 70311 70321
 MEMB PROP PRIS AX   12.0 IX      36.0 IY      16.0 IZ       9.0
 70312 70322
 MEMB PROP PRIS AX   12.0 IX      36.0 IY      16.0 IZ       9.0
 70313 70323
$  |-----------------------------------------|
$  |         EXAMPLE 2                       |
$  V                                         V
 MEMB PROP PRIS AX   15.0 IX      45.0 IY      31.2 IZ      11.2
 71111
 MEMB PROP PRIS AX   15.0 IX      45.0 IY      31.2 IZ      11.2
 71112
 MEMB PROP PRIS AX   15.0 IX      45.0 IY      31.2 IZ      11.2
 71113
$  A                                         A
$  |         EXAMPLE 2                       |
$  |-----------------------------------------|
$
$ CAP MEMBERS
$
 GROUP  '/GP/CAPS'    DEFINITION
 MEMB 6031 THRU   6032
 MEMB 6101                                 $  <------ ADD
 END  GROUP DEFINITION
$ CAP MEMBER PROPERTIES
 MEMBER PROPERTIES PRISMATIC
 6031 THRU 6032 AX   40.0 IX  700000.0 IY  700000.0 IZ     700.0
 6101           AX   40.0 IX  700000.0 IY  700000.0 IZ     700.0 $ ADD
$ RESTRAINER MEMBER PROPERTIES
 MEMBER PROPERTIES PRISMATIC
 802 AX   0.0439
 CONSTANTS
 DENSITY 150.0 ALL
 G 172800. ALL
 CTE 0.0000065 ALL
$ SUPERSTRUCTURE MODULUS OF ELASTICITY
 E  468000.  5011 THRU  5015
 E  468000.  5021 THRU  5026
 E  468000.  5031 THRU  5035
$ COLUMN/S MODULUS OF ELASTICITY
 E  468000. 70211 THRU 70213
 E  468000. 70311 THRU 70313
 E  468000. 70321 THRU 70323
$  CAP/S MODULUS OF ELASTICITY
 E  468000.  6031 THRU  6032
 E  468000.  6101                        $ <------------ ADD
$ RESTRAINER MODULUS OF ELASTICITY
 E 1440000.   802
$ BETA ANGLES FOR COLUMNS
 BETA   -2.5339 70211 THRU 70213
 BETA   31.0886 70311 THRU 70313
 BETA   31.0886 70321 THRU 70323
$  |-----------------------------------------|
$  |         EXAMPLE 2                       |
$  V                                         V
$ SUPERSTRUCTURE MODULUS OF ELASTICITY
 E  468000.  5101 THRU  5105
 E  468000.  5111 THRU  5115
$ COLUMN/S MODULUS OF ELASTICITY
```

```
 E  468000. 71111 THRU 71113
$ BETA ANGLES FOR COLUMNS
 BETA   12.1621 71111 THRU 71113
$  A                                           A
$  |          EXAMPLE 2                        |
$  |-------------------------------------------|
$  ABUTMENT   1  RELEASES
 MEMBER 5011 REL END FOR X  Z
  JOINT 3011 RELEASE          MOM    Y  Z  -
  TH2   -12.7449
$  ABUTMENT   4  RELEASES
  JOINT 3041 RELEASE          MOM    Y  Z  -
  TH2    12.9778 KFX      3600. KFZ      1200.
$   HINGE  RELEASES
 MEMBER 5022 RELEASES END FORCE X MOMENT   Y Z
$  |-------------------------------------------|
$  |          EXAMPLE 2                        |
$  V                                           V
$  ABUTMENT  10  RELEASES
 MEMBER 5101 REL END FOR X
  JOINT 3101 RELEASE          MOM    Y  Z  -
  TH2     5.5129
$  ABUTMENT  12  RELEASES
 MEMBER 5115 REL STA FOR X
  JOINT 3121 RELEASE          MOM    Y  Z  -
  TH2    -4.4871
$  A                                           A
$  |          EXAMPLE 2                        |
$  |-------------------------------------------|
    MEMBER 6101 JOINT END SIZE START 31.995        $ <------ ADD
 INERTIA OF JOINTS LUMPED
$ HINGE WEIGHT
 INERTIA OF JOINTS ADD
      2022    LINEAR ALL            72000.00
      2023    LINEAR ALL            72000.00
      3101    LINEAR ALL            72000.00       $ <----- ADD
      1102    LINEAR ALL            72000.00       $ <----- ADD
$ CAP WEIGHT
 INERTIA OF JOINTS ADD
      1021    LINEAR ALL           192000.00
     40314    LINEAR ALL            24000.00
     40324    LINEAR ALL            24000.00
$  |-------------------------------------------|
$  |          EXAMPLE 2                        |
$  V                                           V
$ CAP WEIGHT
 INERTIA OF JOINTS ADD
      1111    LINEAR ALL           192000.00
$  A                                           A
$  |          EXAMPLE 2                        |
$  |-------------------------------------------|
 DAMPING PERCENTS  5.0   15                       $ <----- MODIFIED
 SHOCK SPECTRUM LOAD ' Z DIR' 'EXAMPLE PROBLEM         '
 SPECTRUM TRANSLATION Z FILE 'S.6GA51' FACTOR 1.0000
 END OF DYNAMIC LOAD
 SHOCK SPECTRUM LOAD ' X DIR' 'EXAMPLE PROBLEM         '
 SPECTRUM TRANSLATION X FILE 'S.6GA51' FACTOR 1.0000
 END OF DYNAMIC LOAD
 LOAD ' TRANS'
 CQC LOAD ' Z DIR'
 LOAD 'LONGIT'
 CQC LOAD ' X DIR'
 LOAD COMB 'CASE 1' 'TRANS PLUS 0.3 TIMES LONGIT       CQC'
 LOAD COMB 'CASE 2' 'LONGIT PLUS 0.3 TIMES TRANS       CQC'
 PRINT STRUCTURAL DATA
 UNITS INCHES
 PLOT DEVICE PLOTTER PAPER 30
 PLOT FORMAT ORIENTATION NON STANDARD    24
 LABEL JOINTS
```

```
 TITLE 'EXAMPLE PROBLEM          '
 TITLE BLOCK
 JOB 'EXAMPLE PROBLEM          '
 FOR '        '
 BY 'STRUBAG'
 DISPLAY THREE DIMENSIONAL
 PLOT FINISH
 UNITS FEET
 ASSEMBLE FOR DYNAMICS REDUCE BAND
 INDEPENDENT DEGREE OF FREEDOM SELECT
 CONDENSE DYNAMIC MATRICES
 DUMP ORTHOGONALITY
 MODAL ANALYSIS HOW  15                            $ <------ MODIFIED
 LIST DYNAMIC NORMALIZED EIGENVECTORS
 LIST DYNAMIC PARTICIPATION FACTORS
 SHOCK SPECTRUM ANALYSIS LOAD  ' Z DIR'   ' X DIR'
 GENERATE RESULTS FOR LOADS ' TRANS' 'LONGIT'
 COMBINE 'CASE 1' ' TRANS' 1.0 'LONGIT' 0.3
 COMBINE 'CASE 2' 'LONGIT' 1.0 ' TRANS' 0.3
 LOAD LIST 'CASE 1' 'CASE 2'
$ LIST ELASTIC COL MEM FORCES (A*R*S LOAD)
 LIST FORCES MEMBERS -
 70211 70213 -
 70311 70313 -
 70321 70323
$ LIST ELAS. RESTRAINER FORCES (A*R*S LOAD)
 LIST FORCES MEMBERS -
  802
$ LIST ELAS. GLOBAL DISP FOR MAJOR JOINTS (A*R*S LOAD)
 LIST DISPLACEMENTS JOINTS -
 3011 1012 1021 2022 2023 1031 1035 3041
 OUTPUT DECIMAL 4
$ LIST ELAS MEM FORCES AT ABUTS AND HINGES (A*R*S LOAD)
 OUTPUT DECIMAL 1
 LIST FORCES MEMBERS -
 5011 5022 5035
$  |-----------------------------------------|
$  |         EXAMPLE 2                       |
$  V                                         V
 OUTPUT DECIMAL 4                          $  <-------- ADD
 LIST FORCES MEMBERS -
 71111 71113
$ LIST ELAS. GLOBAL DISP FOR MAJOR JOINTS (A*R*S LOAD)
 LIST DISPLACEMENTS JOINTS -
 3101 1102 1111 1115 3121
 OUTPUT DECIMAL 4
$ LIST ELAS MEM FORCES AT ABUTS AND HINGES (A*R*S LOAD)
 OUTPUT DECIMAL 1
 LIST FORCES MEMBERS -
 5101 5115
$  A                                         A
$  |         EXAMPLE 2                       |
$  |-----------------------------------------|
  FINISH
  CHANGES
  JOINT 3041 REL MOMENT   Y    Z  -
          KFX  1.0     KFZ  1.0
  ADDITIONS
 PRINT JOINT RELEASES
$ BRIDGES WITH SHARP RADIUS CURVES(CURVES LESS THAN OR EQUAL
$ TO 1000.0 FEET) MAY GIVE A STATIC CHECK UNBALANCE MESSAGE.
$ IGNORE THIS MESAGE AS THE RESULTS OF THE STATICS RUN ARE
$ SATISFACTORY.
$
 INACTIVE MEMBERS -
 802
 LOADING   'W'     'WIND LOAD ON STRUCTURE'
 MEMBER LOADS
          5011  THRU   5015  FORCE  Z  GLOBAL PROJ UNI  W     1.000
```

```
             5021   THRU   5026  FORCE  Z  GLOBAL PROJ UNI  W     1.000
             5031   THRU   5035  FORCE  Z  GLOBAL PROJ UNI  W     1.000
             5011   THRU   5015  FORCE  X  GLOBAL PROJ UNI  W     0.240
             5021   THRU   5026  FORCE  X  GLOBAL PROJ UNI  W     0.240
             5031   THRU   5035  FORCE  X  GLOBAL PROJ UNI  W     0.240
            70211   THRU  70213  FORCE  Z  GLOBAL PROJ UNI  W     1.000
            70311   THRU  70313  FORCE  Z  GLOBAL PROJ UNI  W     1.000
            70321   THRU  70323  FORCE  Z  GLOBAL PROJ UNI  W     1.000
            70211   THRU  70213  FORCE  X  GLOBAL PROJ UNI  W     1.000
            70311   THRU  70313  FORCE  X  GLOBAL PROJ UNI  W     1.000
            70321   THRU  70323  FORCE  X  GLOBAL PROJ UNI  W     1.000
$  |-----------------------------------------|
$  |          EXAMPLE 2                      |
$  V                                         V
 MEMBER LOADS
             5101   THRU   5105  FORCE  Z  GLOBAL PROJ UNI  W     1.000
             5111   THRU   5115  FORCE  Z  GLOBAL PROJ UNI  W     1.000
             5101   THRU   5105  FORCE  X  GLOBAL PROJ UNI  W     0.240
             5111   THRU   5115  FORCE  X  GLOBAL PROJ UNI  W     0.240
            71111   THRU  71113  FORCE  Z  GLOBAL PROJ UNI  W     1.000
            71111   THRU  71113  FORCE  X  GLOBAL PROJ UNI  W     1.000
$  A                                         A
$  |          EXAMPLE 2                      |
$  |-----------------------------------------|
 LOADING   'WL'     'WIND LOAD ON LIVE LOAD'
 MEMBER LOADS
             5011   THRU   5015  FORCE  Z  GLOBAL PROJ UNI  W     0.100
             5011   THRU   5015  MOM    X  GLOBAL PROJ UNI  W     0.850
             5021   THRU   5026  FORCE  Z  GLOBAL PROJ UNI  W     0.100
             5021   THRU   5026  MOM    X  GLOBAL PROJ UNI  W     0.850
             5031   THRU   5035  FORCE  Z  GLOBAL PROJ UNI  W     0.100
             5031   THRU   5035  MOM    X  GLOBAL PROJ UNI  W     0.850
             5011   THRU   5015  FORCE  X              UNI  W     0.040
             5011   THRU   5015  MOM    Z              UNI  W     0.340
             5021   THRU   5026  FORCE  X              UNI  W     0.040
             5021   THRU   5026  MOM    Z              UNI  W     0.340
             5031   THRU   5035  FORCE  X              UNI  W     0.040
             5031   THRU   5035  MOM    Z              UNI  W     0.340
$  |-----------------------------------------|
$  |          EXAMPLE 2                      |
$  V                                         V
 MEMBER LOADS
             5101   THRU   5105  FORCE  Z  GLOBAL PROJ UNI  W     1.000
             5101   THRU   5105  MOM    X  GLOBAL PROJ UNI  W     8.750
             5111   THRU   5115  FORCE  Z  GLOBAL PROJ UNI  W     1.000
             5111   THRU   5115  MOM    X  GLOBAL PROJ UNI  W     8.750
             5101   THRU   5105  FORCE  X              UNI  W     0.400
             5101   THRU   5105  MOM    Z              UNI  W     3.500
             5111   THRU   5115  FORCE  X              UNI  W     0.400
             5111   THRU   5115  MOM    Z              UNI  W     3.500
$  A                                         A
$  |          EXAMPLE 2                      |
$  |-----------------------------------------|
 LOADING   'LF'     'LONGITUDINAL FORCE    '
 MEMBER LOADS
             5011   THRU   5015  FORCE  X  GLOBAL PROJ UNI  W     1.000
             5011   THRU   5015  MOM    Z  GLOBAL PROJ UNI  W     8.500
             5021   THRU   5026  FORCE  X  GLOBAL PROJ UNI  W     1.000
             5021   THRU   5026  MOM    Z  GLOBAL PROJ UNI  W     8.500
             5031   THRU   5035  FORCE  X  GLOBAL PROJ UNI  W     1.000
             5031   THRU   5035  MOM    Z  GLOBAL PROJ UNI  W     8.500
$  |-----------------------------------------|
$  |          EXAMPLE 2                      |
$  V                                         V
 MEMBER LOADS
             5101   THRU   5105  FORCE  X  GLOBAL PROJ UNI  W     1.000
             5101   THRU   5105  MOM    Z  GLOBAL PROJ UNI  W     8.750
             5111   THRU   5115  FORCE  X  GLOBAL PROJ UNI  W     1.000
```

```
          5111  THRU   5115  MOM    Z  GLOBAL PROJ UNI  W     8.750
$  A                                         A
$  |         EXAMPLE 2                       |
$  |-----------------------------------------|
$
  LOADING   'T'     'TEMPERATURE LOAD'
  MEMBER TEMPERATURE LOADS
  '/GP/SUPE'  AXIAL    35.
  '/GP/COLS'  AXIAL    35.
  '/GP/CAPS'  AXIAL    35.
$
$ FOR BENT   2
$
$
  LOADING  'DY -   2'   'TRANS MOMENT DISTRIBUTION'
$ FOR SINGLE COLUMN BENTS USE THE FOLLOWING COMMAND (ADD + 1 OR - 1 TO
$ THE ANSWER)
  MEMBER    70213  END LOAD END   MOMENT Y 1.0
$
  LOADING  'DX -   2'  'LONGIT MOMENT DISTRIBUTION'
$ FOR SINGLE COLUMN BENTS USE THE FOLLOWING COMMAND (ADD + 1 OR - 1 TO
$ THE ANSWER)
  MEMBER    70213  END LOAD END   MOMENT Z 1.0
$
$ FOR BENT   3
$
$
  LOADING  'DY -   3'   'TRANS MOMENT DISTRIBUTION'
  MEMBER   6031  END LOAD START MOMENT Z 1.0
$
  LOADING  'DX -   3'  'LONGIT MOMENT DISTRIBUTION'
  MEMBER   6031  END LOAD START MOMENT X 1.0
$  |-----------------------------------------|
$  |         EXAMPLE 2                       |
$  V                                         V
$
$ FOR BENT  11
$
$
  LOADING  'DY -  11'   'TRANS MOMENT DISTRIBUTION'
$ FOR SINGLE COLUMN BENTS USE THE FOLLOWING COMMAND (ADD + 1 OR - 1 TO
$ THE ANSWER)
  MEMBER    71113  END LOAD END   MOMENT Y 1.0
$
  LOADING  'DX -  11'  'LONGIT MOMENT DISTRIBUTION'
$ FOR SINGLE COLUMN BENTS USE THE FOLLOWING COMMAND (ADD + 1 OR - 1 TO
$ THE ANSWER)
  MEMBER    71113  END LOAD END   MOMENT Z 1.0
$  A                                         A
$  |         EXAMPLE 2                       |
$  |-----------------------------------------|
 STIFFNESS ANALYSIS REDUCE BAND
$  THE COMMAND ABOVE LISTS ALL RESULTS
  OUTPUT DECIMAL        2
$  THE FOLLOWING COMMANDS REFORMAT THE COLUMN FORCES ONLY
  OUTPUT BY MEMBER
$ LIST COLUMN MEMBER FORCES
 LOADING LIST   'CASE 1'  'CASE 2'  'W'  'WL'  'LF' 'T' 'DY -   2', -
'DX -   2' 'CFH1-  2' 'CFH2-  2' 'CFH3-  2' 'CFP1-  2' 'CFP2-  2', -
'CFP3-  2'
 LIST FORCES MEMBER  -
 70211 70213
 LOADING LIST   'CASE 1'  'CASE 2'  'W'  'WL'  'LF' 'T' 'DY -   3', -
'DX -   3' 'CFH1-  3' 'CFH2-  3' 'CFH3-  3' 'CFP1-  3' 'CFP2-  3', -
'CFP3-  3'
 LIST FORCES MEMBER  -
 70311 70313 -
 70321 70323
$  |-----------------------------------------|
```

```
$ |         EXAMPLE 2                        |
$ V                                          V
$ LIST COLUMN MEMBER FORCES
 LOADING LIST 'CASE 1' 'CASE 2' 'D' 'W' 'WL' 'LF' 'T' 'DY -  11', -
'DX -  11' 'CFH1- 11' 'CFH2- 11' 'CFH3- 11' 'CFP1- 11' 'CFP2- 11', -
'CFP3- 11'
 LIST FORCES MEMBER  -
 71111 71113
 FINISH
```